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THE BRICKBVILDER

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THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

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THE BRICKBUILDER is published the 20th of each month.

IN colonial times, and down to a comparatively recent date, to lay brick in Flemish, or in English bond, was a common practise. Specimens of both may still be seen in the older parts of nearly all of our Eastern cities; but we fear that what was formerly a rule — and a very good rule, too — has long since become the rarest exception. This is especially true of New York, where, of all the work done by the present generation of builders, we know but a few righteous examples.

America has gained immensely in many things by adopting the good, rejecting the bad, and avoiding the mistakes of older nations. In the bonding of brickwork this wise policy seems to have been reversed. Notwithstanding the force of both precept and example, we have contracted the inexcusably bad habit of laying brick in vertical tiers, with little more than a pretense at bonding. Worse still, we seem inclined to pursue this retrograde and dangerous career in spite of all warning and remonstrance. The sham that goes under the name of "American bond," and at which people who have seen it for the first time laugh ironically, has not the poor merit of being a successful delusion. Nobody, we suppose, is expected to believe that the four inches of face brick, in which no headers are permitted to appear, can be counted in as an integral part of the wall's thickness. A brick-mason of some thirty years' experience in England assured us, not many days ago, that "to face a wall without using *bona fide* headers is a thing utterly unknown there, — except as a criminal offense." We hope that here, too, there is a time coming when it will be classified in the same category, and similarly branded in public estimation.

The first, but we think the only practical difficulty encountered in this is the various sizes of face brick now in general use, and the want of corresponding sizes of common brick to work with them. These sizes, however, resolve themselves into two classes, the one being a brick of $2\frac{5}{16}$ ins. average thickness, which, with a $\frac{3}{16}$ joint, will course at a common multiple of $2\frac{1}{2}$ in. centers. The other, but much smaller class, comprises the various kinds of Pompeian brick, the approximate thickness of which may be set down at $1\frac{1}{2}$ ins. This with a mortar joint of $\frac{3}{16}$ gives us $1\frac{11}{16}$ ins. as the unit of measurement. It is with the latter class that the obstacles to be overcome appear most formidable; but they are only apparent, and in both cases can be made to vanish.

One way in which this may be done is to have common brick made to the same thickness as the face brick; or just a trifle less, to allow for a necessarily greater degree of irregularity in the bricks, and a more liberal use of mortar in bedding them. That a demand for common brick to be used in this way exists may have been gleaned from many inquiries made by architects from time to time, echoed by THE BRICKBUILDER, and reechoed by some of our contributors. We would be glad to see that demand grow more general and insistent on their part. It would be an encouraging evidence of good intentions, and an augury of awakened interest. We can answer for the brickmaking fraternity that the supply would soon be forthcoming. The movement would be supported by all well-conditioned builders, as nobody knows better than they do the indefensible character of prevailing practises.

So far as the architects are concerned we have given them credit for good intentions, but these of themselves are inadequate. They are entitled, and by virtue of their office empowered, to do more than this. They should insist upon having the kind as well as the quality of material necessary to produce work that will be lastingly serviceable to their clients; therefore creditable to their own judgment, forethought, and integrity. They are supposed to know, and as a rule they do know what is right in such matters; it is equally incumbent upon them to point the way, and to see that the desired end is substantially attained. If not by a faithful discharge of these duties, then we would willingly listen to such other reasons (if any) as may be adduced in vindication of their existence.

It is the policy of this journal to find a market for good materials, and encourage those who seek to propagate honest methods of using them. Not everything that is offered comes up to this standard, but we have not found it at all necessary to single out individual men or things for invidious criticism, much less wholesale denunciation. We have been content to advocate and uphold that which is beyond reproach; leaving that which is otherwise to perish, as it ought, and as it undoubtedly will, from lack of patronage. Pursuing the present subject in a similar spirit, towards a tangible conclusion, we invite feasible suggestions in further elucidation of this question of brick bonding. We anticipate for them, on behalf of our respected readers, a discriminating appreciation, if not a willing acceptance. In any event, their sponsors shall have the opportunity of addressing a large and interested audience, whom we have reason to believe regards the question at issue as one ripe for discussion.

WE are so slow in this country to appreciate the value of proper esthetic treatment of our public work that it comes almost as a matter of course that, when a great undertaking which is primarily of a utilitarian character is undertaken by a municipality,

the result, however satisfactory from a standpoint of mere prosaic fitness, is pretty sure to be hopelessly inartistic. Our lost opportunities are legion, and to them must be added the Boston Subway. This was a piece of work which from its very nature would suggest the use of brick masonry. The past is so full of instances wherein vaulted structures have been made both practical and attractive, and it would seem so natural a desire on the part of our commissioners to at least attempt a species of good looks in connection with subterraneous constructions, that the utter lack of any attempt at anything more than a strictly utilitarian treatment of the problem is certainly disheartening. The stations where the public is supposed to enter and leave the cars — we refer now to the underground portions — are spacious, well arranged, and, considering the conditions, excellently well lighted. We have every assurance that the supporting members are well proportioned and the structure, as a whole, perfectly stable. But the rank Philistinism which would utterly ignore such a splendid opportunity for striking architectural effects as these stations offer is certainly to be deplored. The commission, in its inscrutible wisdom, has seen fit to employ glazed brick quite extensively as a facing to the walls of the stations. So far this is excellent; but not the slightest attempt has been made to do anything more than face a barren, uninteresting wall with a dead white glazed surface. The isolated columns, the iron girders, the brick arches between the beams, all stand out in naked insistence, and the daily traveler through the subway can find nothing more attractive to cheer his eye than the dreary reflections of white from the paint on the columns, the enameling on the beams, and the glazing on the bricks. It is surely not from lack of precedent that the opportunity has been neglected. One has only to go through the new Public Library Building to see how strikingly successful effects can be obtained by combinations of vaulting with the use of either the Guastavino arches or some kindred form of brick or terra-cotta. The subway has been well built, well planned, and has been in the hands of a commission which was able in every respect except in its ability to appreciate the desirability of good looks. In this respect the subway stations present a dismal, hopeless failure.

public, fulfilling as many of their requirements as possible, and increasing the revenue of the company as well as the architectural beauty of the city.

MR. EDMUND M. WHEELWRIGHT'S series on American Schoolhouse Architecture will begin in the November number of THE BRICKBUILDER. The series will comprise probably four articles, which will be published in consecutive issues. Mr. Wheelwright's superior knowledge of the subject, gained by a thorough study of foreign methods of planning and construction, and his experience as city architect of Boston, at a period when many of its best schoolhouses were built, should make this series of added interest and value.

ILLUSTRATED ADVERTISEMENTS.

PANEL executed by the New York Architectural Terra-Cotta Company. Gardner & Pyne, architects. Louis Roncoli, modeler.

The accompanying panel is suggestive of modern locomotion in its latest phase of development; it is likewise more realistic than symbolic in point of conception. This will become sufficiently apparent when it is stated that the panel is intended to be placed over the entrance to a building now in course of erection for the Springfield (Mass.) Street Railroad Company.

To model in perspective a series of scenes, giving the principal features a certain degree of relief, and to treat the subject so that the composition as a whole may appear correct in its lines, when it, in turn, is seen in perspective from various points of view, is a task that has never yet been fully accomplished. The difficulties are inherent, and, beyond a certain point, may be considered insuperable. The best that can be done is but a well-balanced approximation to the truth, and this is as far as Mr. Roncoli has essayed in the present instance. His famous countryman, Ghiberti, did not accomplish much more than this in his bronze gates at Florence, which, though an acknowledged masterpiece in their way, have often been questioned as to the convergence of the vanishing points.

PERSONAL AND CLUB NEWS.

MR. J. C. NIEBEL, architect, 59 Court Street, Brooklyn, N. Y., succeeds to the business of Carl F. Eisenach, who retires from practise.

MR. HAROLD F. ADAMS, architect, formerly associated with Mr. Wm. G. Hoopes, Atlantic City, N. J., has opened an office in the Real Estate and Law Building, Atlantic City, and would be glad to receive catalogues.

THE second annual redesigning competition, held by the T Square Club, of Philadelphia, called for the redesigning of the Reading Railroad Terminal, "under conditions which the citizens of Philadelphia had every right to expect and demand. In consideration of the privilege of building over the streets, which the city owned, councils should have insisted upon the acquirement by the railroad company of the entire block from 11th to 12th Street, and from Market to Filbert Street, and also upon the proper recession of all fronts so as to accommodate the accumulated traffic," says the program. Some of the conditions were: one or more courts of approach; accommodations for shops, stores, a bank, and such trades as would necessarily have to be provided for in this rearrangement; facilities for checking bicycles, and their convenient storage, etc.; waiting places for street cars; hotel accommodations. In general, the building should be considered and arranged to be a central place of convenience for the

In their advertisement, page xiv, R. Guastivano Company show a cut of their large roof construction, being the fourth recently built for the West End Street Railway, of Boston, for their power stations. The cut shows the roof in process of construction, after which the haunches of the arches are concreted over the beams, and the whole surface asphalted and graveled. It is similar in construction to the roof built by them for the Union Railroad Company, of Providence, the Colorado Telegraph Company, and others.

No. 4 of the series of brick and terra-cotta fireplace mantels which is being illustrated in the advertisement of Fiske, Homes & Co., page vii, is one designed by J. A. Schweinfurth, architect, and modeled by Tito Conti, the drawing being by H. F. Briscoe.

The always interesting building of the Exchange Club, Boston, Ball & Dabney, architects, is illustrated in the advertisement of the Boston Fire-Proofing Company on page xi.

The Harbison & Walker Company illustrate in their advertisement for this month, on page xxv, the Conestoga Building at Pittsburg, Penn., Alden & Harlow, architects.

A section of a wall laid up with seam-face granite is shown in the advertisement of the Gilbreth Seam-Face Granite Company, page xxxviii.

Many other advertisements which appear in this month's number have interesting illustrations which have been mentioned before in this column.

Some Important Problems in Construction. I.

BY WM. W. CREHORE, ASSOC. M. AM. SOC. C. E.

THE title selected for these studies is perhaps not as truly significant or descriptive as it might be, since it is the writer's intention more particularly to discuss what not to do and why than to enter upon the statement and solution of any of the numerous problems which are presented by the various conditions of modern construction. General questions as to which of two or more alternatives is the best and most economical might, however, quite properly be propounded like problems for solution, and with this explanation the title may perhaps be allowed to apply.

One of the first things to be decided in designing the skeleton frame of a fire-proof building is whether to use cast-iron or built-steel columns. If the building is to be a high one, or one whose height is many times its least dimension, the necessity for some effectual system of wind bracing will preclude the use of cast-iron columns; for wind bracing must be riveted and fastened to connecting members by rivets, whereas rivets cannot be driven in cast iron without liability of cracking it. Everything considered, perhaps the best and safest course to pursue is to reject cast iron altogether and proceed to use steel throughout; but at present prices, as long as the law does not absolutely prohibit the use of cast iron, there are certain limits between which it is safe and a little less costly than steel. These limits are not by any means to be determined off-hand, nor, unfortunately, by the legal limitations of the use of cast iron. A safe designer will take into account the possibility of making details of connections which will be fully as strong as the members connected.

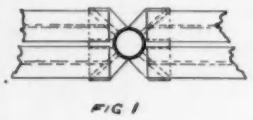


FIG 1

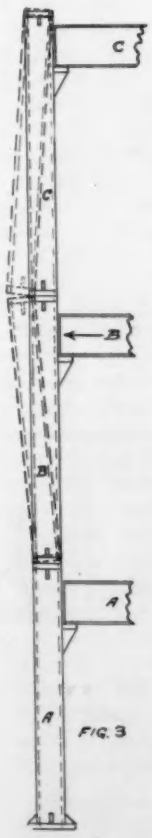


FIG. 3

Fig. 1 shows a 6 in. cast-iron column carrying a 12 in. double beam girder on each side. The total width of this girder over flanges being a little more than twice the diameter of the column, it becomes a serious problem to design a seat and brackets which will convey the load into the body of the column. Fig. 2 represents the same thing in a worse form, as the loads come from adjacent instead of opposite sides of the column, and this eccentric loading causes an additional moment in the shaft of the column. Cast brackets and seats in cases like these are out of proportion to the size of the column, and must of necessity be clumsy and unsuitable, to say the least. The column, although theoretically of sufficient size for the imposed loads were they laid vertically on its shaft, is not large enough to receive them through side brackets.

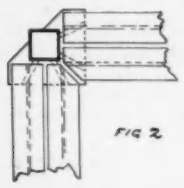


FIG 2

Six or seven inch cast columns are seldom made thicker than one inch, because the same amount of metal put into a larger sized column is more economical. A small column 1 in. thick reduced to three quarters of an inch on one side by the shifting of the core, as is frequently the case, is not heavy enough to withstand the pull of 1¼ and 1½ in. seats and brackets attached to it. The metal in the body of the column in the immediate vicinity of the bracket is more severely stressed than any other portion of the column or the bracket itself, and the tendency of the seats and brackets to pull out of the column is increased. This might have been theoretically inferred, but it is confirmed by observation of cast column failures of recent years.

It seems clear from the preceding remarks that the use of small cast-iron columns is often accompanied by considerable risk, even when they are most carefully designed and used within the legal limitations. In the writer's opinion, the "line" should be "drawn" at the 8 in. column, and nothing smaller should be used except in very rare instances where the loads can be symmetrically imposed. This limitation having been determined, it will be found a little less costly at present prices to use riveted steel columns in the three or four top stories of an ordinarily loaded building, and this method has also the advantage of stiffening the building where stiffness is most needed to resist wind forces. These upper story columns may be made of four angles and a plate, or of four angles latticed. To produce the desired rigidity, all beam and girder connections to them as well as their connections to each other should be riveted.

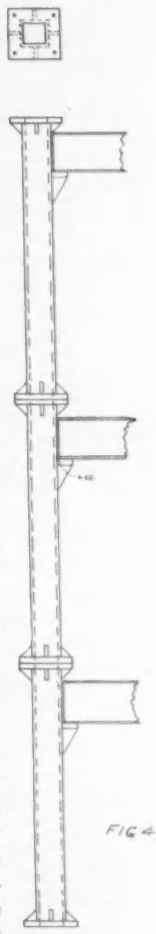


FIG 4.

On the other hand, the 16 in. cast column may be taken as the upper limit. Beyond this steel box columns can be built of angles and plates to better advantage and will be found less costly. In the manufacture of very heavy cast columns it is difficult to keep the core from shifting considerably, owing to the increased action of gravity on the molten metal, causing it to flow underneath and buoy the core up. Then, too, imperfections are less easily detected in heavy castings, and one cannot be as certain of getting good material.

A shaft made up of a number of cast columns is very dependent on the flange connections for its stability. Fig. 3 shows an error (much too common among designers) whereby the stability of the shaft is practically reduced to zero. The column flanges should extend equally in all directions, as shown in Fig. 4, and not in two opposite directions only, as in Fig. 3. A thrust along the line of the beam at B would tend to separate the two columns B and C, and to cause them to take the positions indicated by the dotted lines. The only possible advantage to be gained in this side flange construction is in case of columns built in the wall to permit the brickwork to pass more easily around them, but the risk is too great and it should never be allowed. Column flanges should be reinforced also by small 45 deg. brackets, as shown in Fig. 4, and the bolts should be located as far out as possible in each direction for the purpose of increasing the column's stability or of broadening its base (which amounts to the same thing).

Another error, not now so common as it used to be, is the use of shallow brackets under the beam seats. A 45 deg. bracket for this purpose is too shallow. The depth of the bracket not only affects the resistance of the material to the external shearing forces, but also determines the tensile stress at the point where the seat joins the main body of the column, that is, at the point a in Fig. 4. The deeper the bracket the less this tensile stress becomes for a given load. If we assume the bracket and seat together as one rigid body, then the load from the beam acting downward at P (Fig. 5), a distance x from the column, causes a pull or a tensile stress along the line of the force H and in the opposite direction. It will be easily seen that the amount of this pull, H, is dependent for a given load, P, upon the two distances x and y (or rather their relation to each other), and that this pull increases as x increases, but decreases as y increases. Multiplying each force by its per-

pendicular distance from the point a and equating these products, we have

$$Hy = Px,$$

giving the amount of the pull

$$H = P\frac{x}{y}.$$

Although, strictly speaking, the strain does not all reach the column in the line of H, but is distributed along the whole height of the bracket, still much the greater part of it must be resisted by the metal in the line of the force H, and the deeper the bracket the less this force is. With a 45 deg. bracket the force H is just equal to the load P, and diminishes as the angle between the seat and the bracket increases. These brackets are now usually made with a 60 deg. slope.

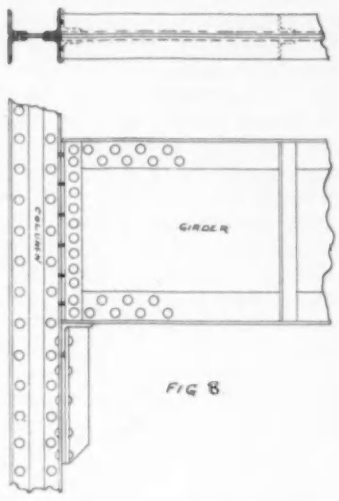


FIG 8

In the preceding discussion the load is assumed to be applied at the very tip end of the column seat, and were the beam to deflect, however slightly, this would be the actual point of its application. To prevent this and thus add strength and stability by applying the load close to the column, the seat is often made slightly sloping (see dotted lines, Fig. 5), say $\frac{1}{16}$ to $\frac{1}{8}$ in. to the foot, just enough to exceed the largest anticipated deflection of the beam.

A similar line of reasoning applies to the brackets or webs of a cast-iron shoe. Such a shoe as is represented in Fig. 6 is too shallow for its width, and the lower flange is subjected to a greater tensile stress at a than that of a deeper shoe would be, as in Fig. 7. A slight unevenness in the grouting of a cast-iron shoe is not an unusual occurrence, and as it is sure to set up irregular and almost incalculable stresses in the metal, a shoe should be designed with an ample factor of safety to begin with. This, it should be noted, does not mean that the metal should be used wastefully merely to increase the weight of the casting, but that it should be properly placed where it will do the most good. The commonest errors are making the shoe too shallow and placing the brackets or webs too far apart, thus weakening the lower flange or base-plate. A slope of 60 degs. usually figures out about right for these shoe brackets also.

Another reprehensible practise is that of leaving columns (especially cast columns) unbraced or insufficiently braced in one direction. It nearly always happens that the principal loads to be carried come from opposite sides of the column only, but it is quite essential, both for economy and stability, that the lesser loads coming from the other directions should be so spaced that a pair of them may be directly supported by the columns, and of the intermediate pairs none should load the girder at its center. In strictly fire-proof construction, where all the beams and columns are of metal and the floors of some solid material, the structure is usually rigid enough if its base is not too narrow; but in a combination semi-fire-proof structure of cast-iron columns, steel girders, and wooden beams, where the beams rest on top of the girders, there is almost no lateral stiffness through the whole length of a line of girders unless special stiffening beams are placed between all columns in the direction at right angles to the girders.

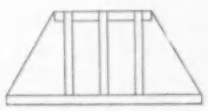


FIG 7

There is a frequent tendency to use the girders in this kind of construction on very long spans, which of course means on spans which bear a high ratio to the depth of the girders. Theoretically there is a fixed limiting span up to which a beam of a given depth may be used with its maximum allowable loading before excessive deflection will take place. In fact, the amount of deflection for quiescent loading may be accurately calculated beforehand. But practically ordinary loading is not always quiescent, and the effect of suddenly applied, moving, or vibratory loads increases disproportionately with the length of the span; so that where any possibility of such loading exists the girders should be made on the longer spans proportionately much deeper than required by the theory of flexure.

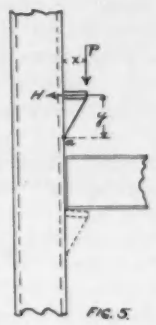


FIG. 5.

In using girders three or four feet deep their ends should be rigidly connected for their full depth, and not left simply to bear on the column's seat, and perhaps with an additional bolt or two at the top of the girder. Such ineffective connections do not develop the girder's full strength under torsional or eccentrically applied forces. Aside from this, the strength of a structure as a whole does not depend upon individual members in it, but upon the united effect of all its members combined, so that it becomes a positive waste of material to connect members to each other in an inferior manner. For this reason deep girders cannot be used to advantage with cast-iron columns. Used with built-steel columns deep girders should be connected by rivets the full depth of the web, as in Fig. 8, and not as in Fig. 9. The open holes show positions of the field rivets.

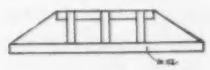


FIG 6

In reviewing an experience of several years in designing new structures and examining old ones, it can be said that the more experience one has the less likely he is to lay down any hard and fast rules of procedure. The conditions affecting each case are so various that construction which might be safely used in one case would be totally unsuitable in another case, while to the inexperienced eye the same two cases might have every appearance of similarity. The indiscriminate use of manufacturers' tables by those whose knowledge of the subject stops there often leads to incongruous, not to say harmful, results in practise. It reminds one of the young dressmaker who started out by attempting to fit all her customers with the same pattern. Tables and formulæ are exceedingly useful when rightly understood and applied, but a thorough acquaintance with their limitations in actual practise, as well as the power to know good from bad practise, is a necessary preliminary to their intelligent application.

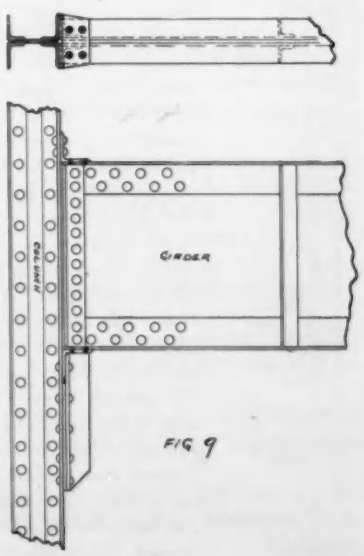


FIG 9

THERE can be no doubt that the best windows for brick churches are either those beautiful Italian developments of plate tracery in which all the bricks are carefully cut and rubbed for their proper place, or those in which, within an enclosing arch of line upon line of brickwork, a small portion of stone is used for the traceries.—*Street.*

Architectural Terra-Cotta.

BY THOMAS CUSACK.

(*Continued.*)

THE building now before us (Fig. 39) will be found to coincide in many things with the one chosen as the subject of last example, besides the construction of its cornice, of which more anon. This similarity is sufficiently marked to suggest comparison, which, if made, must reveal some of the points of divergence. But first, as to the resemblance. The two buildings were designed and erected simultaneously; granite being used in the lower stories of both, with gray terra-cotta and brick for what may be considered the shaft of the building. The last story and the main cornice are, in each case, entirely of terra-cotta, no face brick being used above the lintels of the story below. They were, we presume, planned to meet the greatest number of known wants, with the least sacrifice of space, and, in other respects, carried out in accordance with approved practise, the best classical authorities available having been consulted and followed (perhaps too literally) in determining their respective styles of exterior detail. At this point they begin to part company. They are by different architects, belong to different cities, and have nothing in common as to origin or ownership. The former building is fifteen stories, and standing on a corner, has one frontage on a side street, and the other on a thoroughfare more widely known than any other on the American continent. The remaining sides abut on adjoining property to about one third of that height, above which they are frankly exposed as rear walls, pending a similar upward movement on the sites now occupied by these dwarfed, diminutive relics of a bygone time. The latter, standing free from encroachments on all sides, afforded what we can well imagine to have been an eagerly accepted opportunity for harmonious treatment on four elevations. Here was a chance for the erection of an architectural entity, prized, we presume, in proportion to its exceeding rarity in the business center of most cities. The opportunity, in this case, has not been wasted. For, if "design, order, and congruity" be the essentials of good architecture, we have them embodied to a degree that is both creditable and encouraging. The fortunate architects were Mr. James Windrim and his son, John T. Windrim, of Philadelphia. The building virtually belongs to that city, being part of the Girard estate, of which Mr. Joseph L. Caven is chairman of committee, and to whose enterprise the success of this project is said to be largely due.

FIG. 39. GIRARD BUILDING, PHILADELPHIA, PA.
James Windrim & Son, Architects.

More closely examined, the fundamental difference will be found to consist in the adoption of the Ionic order as the prevailing keynote, in preference to the Doric of last example. This has been done subject, of course, to such modifications as become expedient in applying either of them to a thirteen-story building. Avoiding, so far as is possible, anything in the nature of an invidious comparison, we think this is unquestionably the more manageable of the two orders; and of that the building now under notice affords a particularly happy illustration. The freedom with which it has been handled by Mr. Windrim, without incongruity, is not merely an evidence of care and deliberation; it shows that he had a comprehensive grasp of his onerous undertaking as a whole and from the outset. There are few, if any, indications of his having taken hold inconsiderately of an unknown quantity, for in no case (to use an inelegant but very expressive phrase) has the tail been able to wag the dog. If there be an exception to this throughout the building, it is probably confined to the columns at the thirteenth story. There is nothing to be said against the use of these columns *per se;* on the contrary, much might be urged in their favor, but, considering their distance from the average spectator, a certain exaggeration with the view to greater boldness of detail would have been quite justifiable. If "'twill be recorded for a precedent," then so much the better in all such cases, provided it is done with judgment and discretion. The persuasive Portia, with an artist's eye to a still more effective climax, did not deign to "alter a decree established"; yet, with due deference to the strict laws of Venice, whereof she was adjudged a well-deserving pillar, there are times and places (of which this is an instance) where the eye is the ultimate arbiter, when one may say with Bassanio: "To do a great right, do a little wrong." Columns of the same general proportions are used in the vestibule, etc., in which positions they are unexceptionable. But in those placed at a height of 160 ft. from the street level, we think the number of flutes might have been reduced to, say eighteen, allowing a proportionate increase in the size of flute and fillet. For the same reason the finer lines in capital could have been omitted, and its projection, especially that of the abacus, increased with obvious advantage. As it is, the striation in the columns is not sufficiently perceptible, and the capitals appear rather meager, therefore the general effect less satisfying to the eye than could have been desired in this otherwise spirited composition.

To be sure, this, like other tall buildings, is bound to be viewed from a variety of points other than the one already mentioned. This much we gladly admit in extenuation of the foregoing criticism. An ever-increasing population is destined to spend most of its waking moments at various levels in surrounding buildings of corresponding height. From these points much of the detail will be seen under more favorable conditions. It may likewise be fairly conceded that no stage setting has been invented that will suit all parts of the house. With that understanding, a compromise is made between the parquet and the dress circle; less regard being had to the supposedly less critical "family circle," and no attempt

The construction of balconies at the tenth story is withheld for subsequent discussion, in connection with others of a like character.—T. C.

made (in this one particular) to "split the ears of the groundlings," ye gods of the gallery. So, too, in another branch of the arts — painting; whether in the works of old or, shall we say, new masters, they are seen best from an approximately correct focus; adjusted instinctively to the vision of the individual spectator. But after all, in the case of buildings — it may be from force of habit

At the fifth story, and again at every second story up to the eleventh, the wall line recedes three quarters of an inch, or 3 ins. in all, making a total difference of 6 ins. each way in the plan area of the building, at bottom and top respectively. Practically as well as æsthetically considered, it will be admitted that this gradual batter is equally beneficial in all high buildings; and if anybody is in

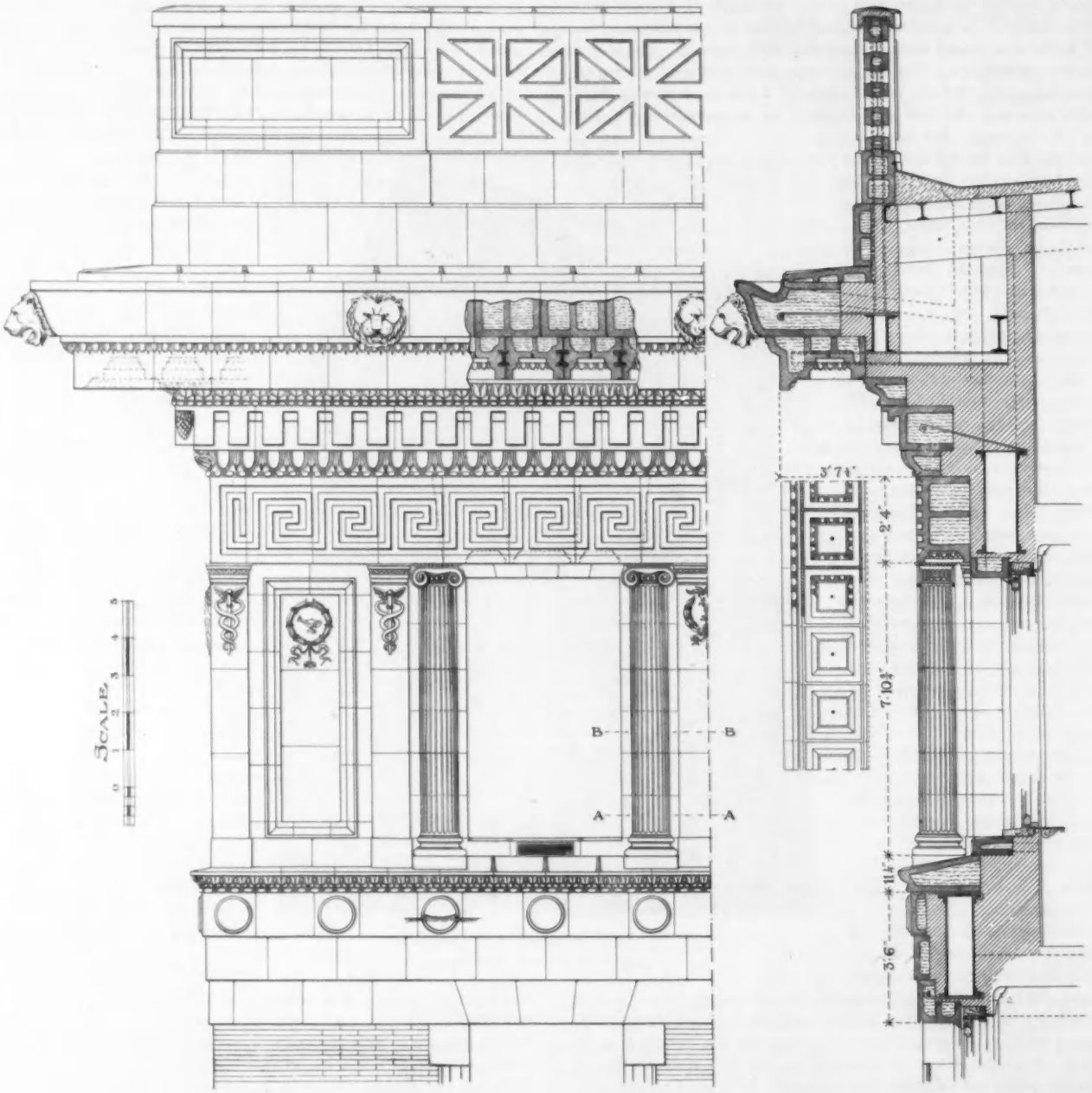


FIG. 40.

coeval with the human species, amounting to a pre-"sky-scraper" prejudice — most of us are inclined to fix our judgment seat at some coign of vantage on the opposite sidewalk. Of the future we must speak with reserve; but from this point of view the buildings of the present, like those of the past, will be criticized, commended, or condemned. It may be noted in this connection that the well-known optical illusion which makes a high building with parallel sides appear top heavy has not been ignored or forgotten in this one, where the remedy is simple, and the result undoubtedly effectual.

search of a precedent, Mr. Windrim has furnished one here that is not likely to be assailed.

A true section through thirteenth story, the cornice and parapet above, with part elevation of same, is shown at Fig. 40 as executed. At Fig. 41 are plans through one of the piers showing their construction, from which it will be seen that all the blocks are made to alternate; breaking bond at every course, except at back of square shaft, in which provision is made for cramping it to the adjoining block; which, in turn, is locked in position at each suc-

ceeding course. In addition to this, the brick backing is built into the chambers of the blocks and around the main column; an example of well-knit composite construction, the strength and reliability of which it is impossible to gainsay. No misplaced effort this, in a building bearing the name of Stephen Girard, whose biography was among the school books of the present writer. It is not unworthy, in point of strength and tenacity, the business methods of the old sea captain, from whose magnificent bequest this building is but an offshoot — albeit, we think, an enduring one.

The fret course forming frieze is jointed vertically throughout, to save cutting through the pattern diagonally. This is on the face only, however, and to a depth of about 3 ins. in the blocks spanning apertures below, in which case the joints are radial to the remainder of their depth; thus forming an arch-lintel. This principle of construction we have from the Greeks, and yet we are often asked to believe that they had no knowledge of an arch! while their more enterprising successors are given all the credit of that invention.

The cornice has a total projection of 5 ft. 6 ins. from wall line to tip of lion's head; and is carried by 4 in. 12 lb. I beams, spaced on 1 ft. 7 in. centers. These cantilevers might have been farther

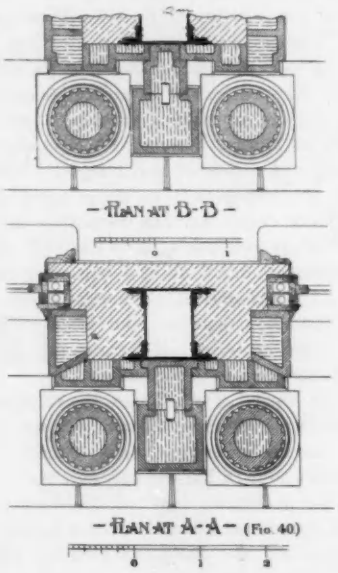


FIG. 41.

apart, but their position is determined arbitrarily by the arrangement of paneling in the soffit; which, for reasons to be explained presently, had to be uniform in size, and, as nearly as possible, rectangular. The vertical joint, as it approaches the lower surface, is deflected from center of rail just enough to avoid cutting through the row of buttons at that point. In other respects, the method of inserting the I beams and of setting the blocks themselves does not differ materially from those described in last example. To such as have noted what there was to say in that connection, it will not be needful to add much on this occasion. Those who have not done so cannot do better than accept our invitation in this regard, and refer back to last issue of this journal. If it serves no other purpose, it will at least spare us the weariness of a twice-told tale.

The two 12 in. channels seen directly under the superincumbent parapet are well placed. They equalize the weight resting on them and distribute it over the cantilevers below, and they, being securely bracketed to a 12 in. I beam running between main columns, require no better fulcrum than the solid brick and terra-cotta on which they rest. The size of these channels may be in excess of actual requirements; but as to that, we defer to the opinion of the capable engineer who fixed the weight of section to be used; if a fault, it is on the side of safety. The pierced parapet is made in single blocks, as shown, with a series of stanchions passing up between them; to these is secured a continuous channel, into which the blocks are molded to fit snugly between the flanges. The top coping is then bedded down in cement, securing the iron from atmospheric action; *minus* exposed tie-rods and stays, which, even on a roof, can hardly be divested of an unpleasant suggestiveness. Do what we may, they seem to shape themselves into alphabet from which we involuntarily spell out — "hold me up until I get paid for"; then come disturbing visions of sheet metal, followed by symptoms of *mal de mer*.

In the panels of the cornice soffit, to which allusion has been made, there is a fanciful device for artificial lighting, which, if not unique, is an evidence of progressive thought and resource. Instead of the usual rosette, an incandescent bulb is inserted in the center of each panel, which, like Goldsmith's bedstead, is "contrived a double debt to pay." This row of pendants marks the place of a conventional ornament from the rising until the going down of the sun. When old Sol has disappeared for the day, away to the west of Fairmount Park, the building will become outlined by a fringe of luminous jets, from which its detail may be studied under a subdued light; for, in truth, a fixed planetary system of its own will begin to twinkle, as is the custom of stars of greater magnitude in the milky way. If modern invention has robbed life of half its poetry, it has brought compensating enjoyments within the reach of all, since the founder of Girard College went aloft for the last time in 1831. Thus does science pay tribute to art, — to the fine as well as to the industrial arts, — for in architecture, rightly understood, and at its best, we have a blending of both.

SHATTERED SURFACES ON BRICKS.

FOR many years architects have been puzzled to account for the "blistering" so frequently found on otherwise sound bricks. It commences by the development of minute cracks on the surface, radiating from a central point, and the center gradually becomes lifted up so as to form a shallow miniature cone. Eventually this may drop off, leaving a scar on the surface, and rendering the whole unsightly. This phenomenon has generally been ascribed to chemical action, and for working out the problem it has been assumed that the center of the disturbance is a piece of lime (burnt chalk, for instance), which, by slaking, expands and produces the cracks alluded to. Of course, there can be no question that lime is often guilty in cracking bricks; but we feel certain that in the case of the blistering above referred to, lime is not the culprit. For you may examine as many of these shattered surfaces as you like, and you will find that the phenomenon is as clearly pronounced in those bricks which do not contain lime lumps as in those which do. Others have suggested that the scaling is due to the accumulation of moisture behind the skin, or real surface of the brick, and they have suggested that the damp course should be improved, and there is much in that contention. At the same time it is undeniable that shattered surfaces are seen under such conditions that the damp course could not be held responsible, and it frequently happens that out of several square yards of brickwork, only a dozen or so of the bricks are affected in the manner now indicated. The writer is under the impression that much of this scarring is due to unequal contraction and expansion in heterogeneous bricks, and it shows that the brick earth has not been thoroughly pugged in the first place. Even a cursory examination shows that these low-grade bricks are full of hard pellets, and these would expand and contract at different rates to the comparatively looser material. A cone would tend to form over these pellets at the point of least resistance — and that would be at the surface — in much the same way as a sheet of lead becomes corrugated when used as sink lining, owing to the alternate application of hot and cold water.— *The British Brickbuilder.*

The Art of Building among the Romans.

Translated from the French of AUGUSTE CHOISY by Arthur J. Dillon.

PART III.

CHAPTER II.

THE ART OF BUILDING AND THE ORGANIZATION OF THE WORKING CLASSES.

(Continued.)

THE servile condition of the corporations was the consequence of an evidently vicious economic system; but to the credit of the Roman law makers, it must be said that they always endeavored to keep this dependence within the limits made necessary by their political system; and the same principle that led them to respect municipal franchises kept them from all useless interference in the interior management of the workingmen's corporations. This is shown even in the decemviral laws. The law of the XII. Tables says, "Power is given to corporations to organize themselves in any manner they please, provided they do not infringe the public law."[1] And it was by virtue of this broad tolerance that the workingmen were enabled to establish separate associations among themselves, to place themselves under the direction or financial responsibility of some more enterprising or wealthy workman who could interpose between them and the State, dealing, usually under bond, with the magistrates who were charged with the duty of erecting public buildings, and playing the rôle of an actual contractor (redemptor or locator operis).[2]

Moreover, there was unconsciously formed an administration in each corporation entirely distinct from the general administration of the city.[3]

The Senate reserved the right of authorizing or suspending the meetings of the corporations; but, once authorized, the corporation had an existence of its own independently of that of the city of which it was a part; it made its own special police regulations, some of which have come down to us; and it created in itself a series of officers whose functions and mutual subordination seem copied from the organization of the Roman city. Far more than the city, the corporations were the ties that united the Roman workingmen, and their lives were so concentrated about them that they came to date the years, even in public acts, from the time of the foundation of their special corporation.

Just as the municipalities, the corporations were divided into centuries and decuries, under chiefs ordinarily elective, known as masters, quinquennials, etc.; the members placed themselves collectively under patrons and took honorary associates; they met on certain days in meeting places, which are designated scholæ in the inscriptions; and there they celebrated feasts from which religion was rarely missing. They had their priests, their temples, and a complete system of religious institutions that persisted even until after the triumph of Christianity, and called down on such corporations that still retained the pagan tinge all the rigor of the laws of the emperors who succeeded Constantine.[4] Besides the religious and administrative divisions, there was another division, founded on the nature of the occupations followed by the members of the same college. The corporations were divided into distinct classes of workingmen, whose sharply separated prerogatives marked the extreme division that existed in industrial operations. As far as concerns the collegium structorum, or corporation of workingmen who had charge of Roman masonry, I have not been able to find with any certainty the names of the categories whose existence I have indicated; this college left no traces except in short inscriptions, and it is to be hoped that new discoveries will supply us with the documents that are still lacking in its history. But if we judge from the corporation of aquarii whose details are given by Frontinus, the division of labor was marked in the organization of the corporations by very distinct categories. But whether this division coincided with that into centuries and decuries is a question on which the documents so far seem to throw no light.

Frontinus (de Aquæd., 177) divides the corporation of aquarii into villici, castellarii, circitores, silicarii, tectores, etc. I will not stop here to discuss the meaning of these distinctions, which would lead me far from my subject, but will only note their multiplicity and call attention to the deductions that can be drawn therefrom. The aquarii, it is true, constituted a familia publica and not a corporation properly so called, but the distinction between corporations and

[1] Digest., Lib. XLVII., tit. XXII., l. 4. Cf. Dig., Lib. III., tit. IV., l. 1; Lamprid., Alex. Sev., Cap. XXXIII.

[2] The attributes of contractors are fixed by the Digest, Lib. L., tit. X., l. 2, § 1. For evidence that the bargains with the contractors were usually made under bond, see Cic., in Verrem, Act II., Lib. 1, Cap. 54–56. Cf. the Lex puteolana, p. 144, etc. The same custom is brought out in the account of a difficulty that arose between Q. Cicero and his contractor (Cic. ep. ad Q. Frat., Lib. III., ep. 1, § 5). See also Cic., ad Attic., Lib. IV., ep. XVI., § 14; and finally, the numerous conventional inscriptions, such as "Opus ex . . . HS faciendum locare," everywhere the "locatore" or "redemptor" seems to undertake the responsibility of executing the work at his own risk, in return for a round sum. Ex.: Orell. 3148; 3277; 3325; 4616; 6605; 6609; 7420 a θ, a κ, a λ; 1476 (with the correction of M. Henzen), etc. (On the customary bargains of this nature among the Greeks, see Rangabé, Ant. hell., 771; Corp. inscrip. gr., 2266).

[3] Below is a table of the most important texts in support of this account of the internal organization of the corporations, and of safeguards opposed to them by the central administration;

1st. Intervention of the government into the internal affairs of the corporations.

The right retained by the Senate to forbid the meetings of the workingman's corporations,

Digest, Lib. III., tit. IV., l. 1; Lib. XLVII., tit. XXII., l. 3:

Orelli, 2797, 3140, 4075, 4115, 4235 . . .

Corporations where the number of members was limited by the government,

Plin. Epist., Lib. X., ep. 42.

2d. Existence and examples of an internal police freely accepted by the corporations,

Digest, Lib. XLVII., tit. XXII., l. 4.

Orelli, 2417, 6086.

3d. Division into centuries and decuries,

Orelli, 4060, 4071, 4085, 4137.

4th. Hierarchy and magistracy of the corporations,

Ordo collegii, Orelli, 2417, 4115.

Magistri, Orelli, 4054. . . . 4137.

Quinquennales, Orelli, 4054. . . . 4137.

Plebs, Orelli, 4054. . . . 4137.

Offices whose hierarchical order is distinctly shown,

Actor or Syndicus, Digest, Lib. III., tit. IV., l. 1.

Præfectus, Orelli, 7198.

Quæstores, Orelli, 2863.

Curatores, Orelli, 7194.

Scribæ, Orelli, 1687.

Honorary titles,

Pater collegii, Orelli, 4134.

Patronus collegii, Orelli, 4054. . . . 4137.

Immunis collegii, Orelli, 4137.

5th. Election in the nomination of certain officers of the corporations,

Orelli, 4057.

Reservations in favor of the government,

Orelli, 2163.

6th. Religious organization of the corporations,

Priest of the corporation, Orelli, 4094, 7213.

Temple, Orelli, 4133.

Special divinities, Orelli, 1710, 1711, 4122.

Funerals, Orelli, 4107.

Banquets, Orelli, 6086.

7th. Slavery in the corporations,

Cic., in Pisonem, Cap. IV.

Digest, Lib. XLVII., tit. XXII., l. 3, § 2; Lib. XXIX., tit. II., l. 25. § 1.

Orelli, 7214, 2886, and particularly inscrip. No. 6086 where slaves are put on a footing of equality with freemen.

Names of freedmen, Orelli, 3019.

8th. Civil rights of the corporations,

Rights of proprietorship, Digest, Lib. X., tit. IV., l. 7, § 3.

Colleges forbidden, at least in principle, to receive legacies,

Cod. Justin., Lib. VI., tit. XXIV., l. 8.

Exceptions to the rule,

Orelli, 4080; Murat., 516, 1.

9th. Various details,

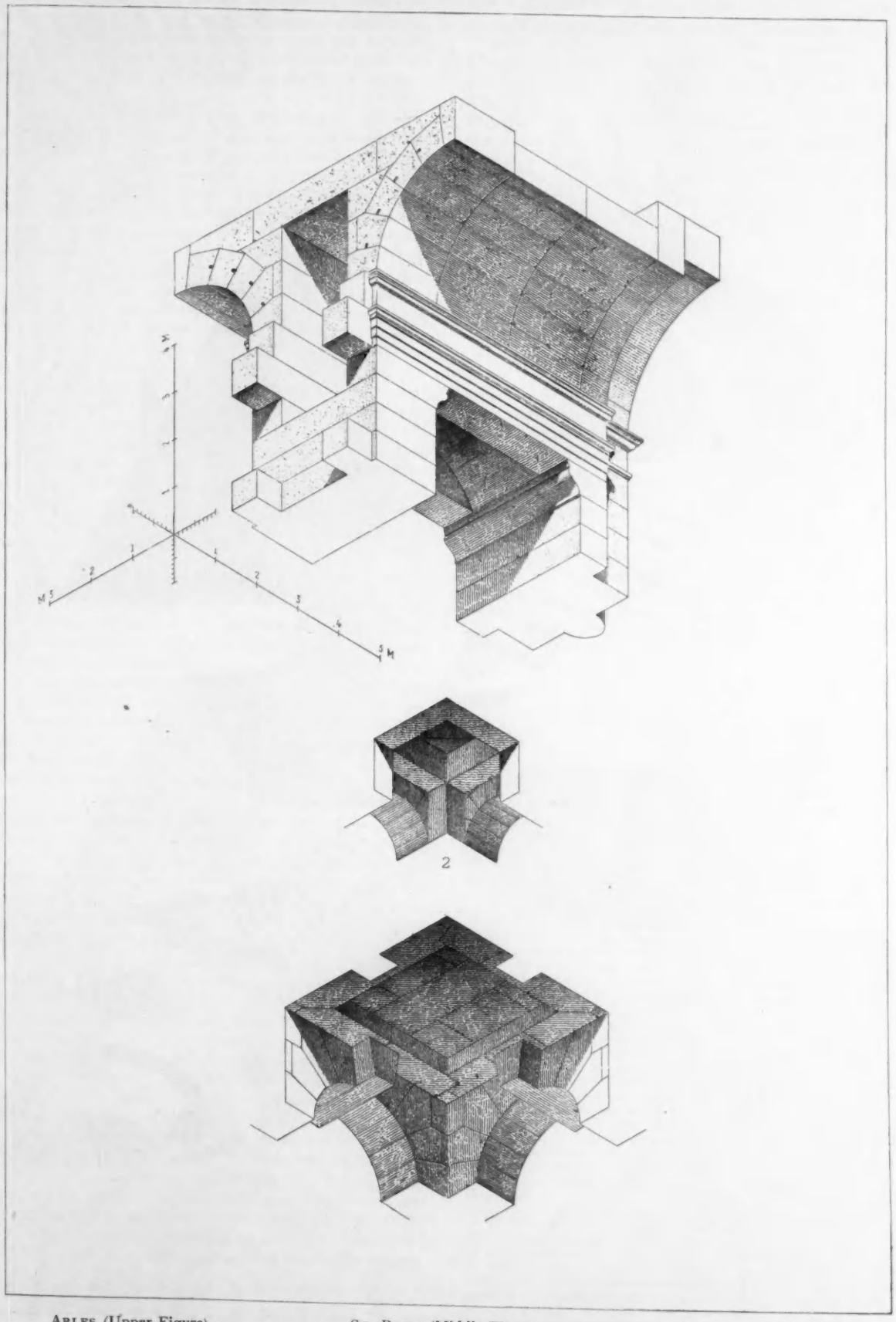
Common treasury, Orelli, 1702, Digest, Lib. III., tit. IV., Lib. I.

Special chronology, Orelli, 1702, 820, 3891, 4064.

Meeting places (Scholæ), Orelli, 4088 . . . .

Seals of certain corporations, Orelli, 2395.

[4] It was for such cause that the Emperor Honorius made a law against the dendrophori and the centonarii which excluded them from Roman society (Cod. Theod., Lib. XVI., tit. X., l. 20).



ARLES (Upper Figure). ST. REMY (Middle Figure). VIENNE (Lower Figure).

PLATE XVII. THE ART OF BUILDING AMONG THE ROMANS.

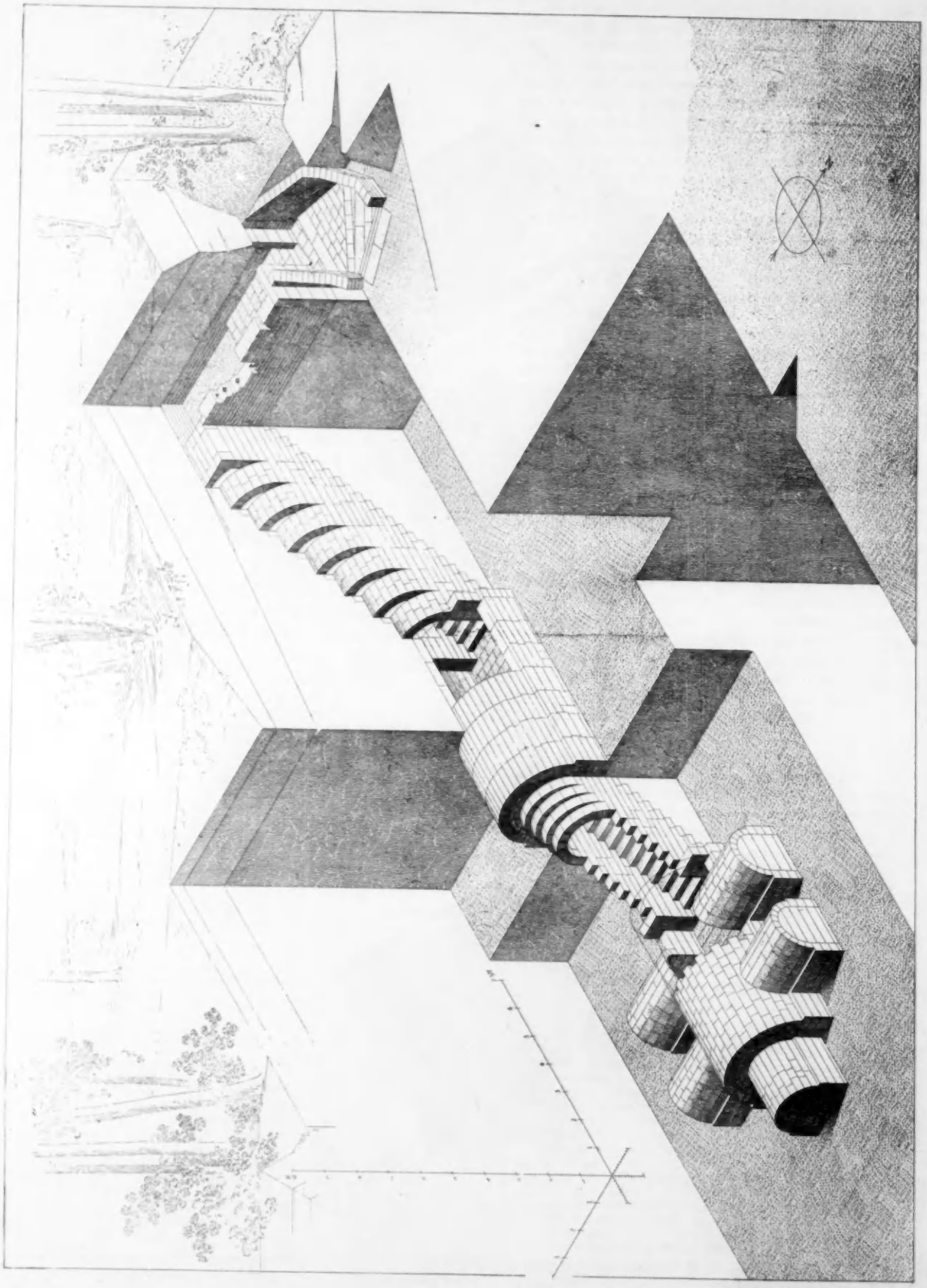


PLATE XVIII. THE ART OF BUILDING AMONG THE ROMANS.
FORET DE RETZ.

the familæ publicæ seemed to consist in the exclusively servile condition of the members of the latter body. Moreover, the reasons for the division into classes were the same in both cases, and the most evident conclusions lead to the supposition that it existed in the corporations just the same as in the familia publica that is the best known to us.

Is it even necessary to have recourse to the analogy? The wide division of functions is written, as might be said, in the structure of the edifices. I will take up an example previously cited, the Coliseum (Plate XXII). We saw that each part of this gigantic building constituted a separate piece of construction; that there were special work-yards and different workmen for the body of the walls and the pilasters that terminate them; that a pier of squared stone, placed in the rough rubble of brickwork, was built by other workmen from those that laid the filling of the walls. Sometimes the work of the mason and that of the stone-setter were conceived in contrary views; the concrete vaults of Provence, compared with the vaults of cut stone, furnish an example of this queer contradiction of principles. Moreover, the sharp distinction made by the Romans between the structure and the decoration is significant; it evidently corresponds to a clearly marked separation between the classes of artisans who erected the buildings and those who ornamented them; perhaps a place must be given to the rivalries that are brought about by such a system of brotherhoods, and we may see that even the paltry jealousies of the workmen of the empire, the least details of their history, are marked in the works they bequeathed us.

The custom of placing the contractors under bond had also marked results, so that it is possible to distinguish to-day between the works executed by contract and those built directly by the State through its own agents.

Frontinus insists on this distinction (de Aquæd., 119) and a single example is sufficient to make it clear. We spoke of the amphitheater of Verona, and cited the incorrectness of details; among others, the flat arches, where the stones, scarcely squared up, show everywhere negligence or mistakes; this is an edifice built by the State by means of irresponsible labor; perhaps it was done by corvees, but it is certain that the amphitheater of Verona was not the work of a contractor bound, in return for an agreed sum, to the strict application of the rules of his art. Certainly it was not by contracts that the Greeks obtained those perfect works whose ruins we still admire; that method was sufficient for the building of the walls of the Pireus, but in building the Pandrosium, the State dealt directly with each of the workmen it wished to employ on its works.[1] The Romans followed, for their purely utilitarian constructions, the same course as the Greeks took in building the walls of the Pireus; they simply made one of those contracts of which the celebrated contract of Pouzzoli is the type.[2] The building was minutely described, but the methods to be followed were left to the device of the contractor. The construction was entirely under his care, and he only could profit by any improvements he should make in it,—an important point, for it explains the reason of the personal interest which resulted in the introduction of the many ingenious artifices that were employed to render the auxiliary work simpler or more economical.

But a detail that was more closely connected with the organization of the corporations had a still stronger and more distinct influence on the future of Roman construction; this was the regulations that fixed the methods of the art of building in every corporation, and that consecrated, it might be said, all the lessons of the past. The corporations were not satisfied in following the regulations of order and discipline; aside from the articles that treated of the policing of the associations, the lex collegii comprised technical prescriptions similar to the statutes that forbade members of our ancient guilds following vicious methods, or that rendered certain traditional methods obligatory. These ordinances were retained in the corporations and, doubtless, were never made entirely public; so that it is easier to establish their existence than to determine their details. Those that are the best known belong to the corporation of fullones. Pliny gives them entire, and adds that they were submitted to the sanction of the people and voted as laws of the State. Evidently this was not an isolated case; and limiting ourselves to our special subject, it is quite reasonable to admit that there were regulations relative to construction when we see that the Romans fixed the treatment of woven goods by law; furthermore, it is known through evidence in Frontinus that a law fixed the seasons when works in masonry could be carried on, and the season when they should be suspended because they could not be executed with success (Front, de Aquæd., 123).[3]

On the whole, these corporations resemble the institutions of the middle ages by a remarkable conformity of institutions and customs; and, if it were allowable to neglect the part occupied by slavery in the ancient corporations, one might say that the ones were the likeness and continuation of the others.

The corporations had under their orders—and sometimes included among their members—a large number of slaves; and there is no doubt that the cooperation of this class, whom the ancients spared but little, aided greatly in making the rude methods of Roman construction possible. But the distinction that separated slaves from freemen in the corporations must not be exaggerated; there were, perhaps, some reasons to make this distinction sharp in the corporations of builders, but in the other corporations they were not so great. By a privilege that one would little expect to find in ancient society, slaves, or foreigners, affiliated to the corporations seem often to have been put on an equal footing with freemen or Roman citizens; and on reading some of the regulations of the corporations that have been preserved in inscriptions, one is astonished by the perfect equality that seems to have existed here between the two classes, elsewhere so profoundly separated.[4]

[1] See Rangabé, Ant. hell., inscrip. No. 771, for the walls of the Pireus, and inscrip. Nos. 56 to 60 for the Pandrosium.

[2] Orell., 6428.

[3] This regulation contained three principal parts:

1st. To commence masonry not sooner than April 1.

2d. To suspend operations during the great heat of summer, in order to avoid the sudden drying of mortar.

3d. To finish work before November 1.

The last article calls for a comparison which I think quite useful. By a remarkable coincidence it is this same date of the first of November that is indicated in the Lex puteolana before cited (Corps. inscrip. No. 577), as the date when the work should be completed. It is perhaps a fortuitous coincidence, but it seems natural to explain it by attributing a common origin to the two documents, which would then be distinct enunciations of the same custom to which Frontinus alludes, recommending it "as an excellent practise, though seldom observed in spite of the law that prescribes it."

I do not know whether we should place in the same series the extract from the leges operum, given by Pliny (Hist. nat. XXXVI., 55), which forbids contractors from using lime less than three months old; these leges operum—the Lex puteolana is an example of them—seemed to have less the character of general laws than of special agreements in particular cases.

For the regulation in form of a law imposed on the collegium fullonum see Pliny, Hist. Nat., XXXV., 57.

[4] To complete this article a list of the principal corporations that were occupied in public works is necessary, which is the object of this note.

1st. We have first the Collegium structorum. This corporation was composed exclusively of men working on rubble masonry (struere, structura is never applied to works of cut stone without mortar) The Colleg. structorum is mentioned in the following inscriptions:—

Gruter, p. 106, 8; 646, 6; 1002, 1; 1117, 10 (?); Orelli, No. 6354: this inscrip. is noticeable in that it establishes the incorporation of slaves in the Colleg. structorum.

Spon. Miscell. ant., p. 231. This inscrip. seems to indicate a special category of structoris parietarii in the Colleg. structorum. The Digest also seems to distinguish the arcuarii who constructed vaults from the structoris (Lib. I., tit. VI., l. 6).

Privileges: The structores were included in the list of 32 professions that were exempted from all public charges, and particularly from the corvee by a law of Constantine (Cod. Theod., Lib. XIII., tit. IV., l. 2).

2d. With the Colleg structorum there may be cited a series of clearly distinct corporations, comprising the workmen occupied in preparing blocks of dressed stone to be used without mortar. With the structores they enjoyed the complete exemption given by the constitution of Constantine. Their names were Lapidarii, Maffei, Mus. Veron., 130, 1; Orelli, 4208, 4220; Marmorarii, Orelli, 4219, 4220, 7245; Quadratarii; Godefroy, Cod. Theod., commentary on the text cited.

3d. The group of corporations which we assemble because they are almost invariably associated in the texts, the fabri ferrarii, tignarii, centonarii, dendrophori:

(*a*) The fabri ferrarii, or simply fabri, worked in metal used in building.

(*b*) The tignarii worked in wood, included in the list of exempts (Cod. Theod., Lib. XIII., tit. IV., l. 2) and to which were attached either as subdivisions or as allied trades certain secondary professions, of which a list will be interesting because it gives a measure of the division of labor of which we have so often spoken.

The Clavarii materiarum (Orelli 4164), whose special duty was to prepare the dowels

The institution of corporations as shown by this summary review seems to carry as a consequence these general facts: —

1st. It should have assured the regular execution of public works, but, in return, to have lent itself but little to changes and innovations. It is the fate of all systems, where detailed regulations are interposed between the agents and the object, to lead quickly to formulas, to consecrated types, which may be excellent but which are unchangeable. This happened to Roman construction. The moment of its taking form was a time of a general overturning of ancient institutions, but the period of formation was brief and suddenly the methods became fixed; and, as we have already had occasion to say, they remained invariable for nearly four centuries, from the reign of Augustus to the time of the final removal of the seat of the empire.

2d. Corporations such as these, whose membership is hereditary, who govern themselves, and whose territorial limits are more or less narrow, will quickly develop differences in their manner of working that will distinguish them from each other. Two corporations bearing the same name, in different municipalities are really entirely separate and distinct and have each its own traditions; so that, in surveying the system of the working classes of antiquity, it is less astonishing to find some differences of detail in the methods used in different cities than it is to find, in all these methods, a certain uniformity that extends from one end of the empire to the other.[1]

used in assemblages. The Sectores materiarum (Orelli, 4278), who sawed the timber. The Lignarii (Orelli, 4265); and finally, the Fabri intestinarii (Orelli, 4182), who did the lighter woodwork for the interior of buildings.

(*c*) The two last professions that were part of this group were the dendrophori and the centonarii, of whom little is known.

The dendrophori can be taken either as those employed in taking care of the forests, or else in hoisting the timbers used in the scaffoldings. There are two opinions as to the functions of the centonarii; one of them holds that they made coarse clothing (vestarius centonarus; Orelli, 4296) from fragments of cloth, or else the thick covers which were used, according to Vegecus (Lib. IV., Cap. XVII.), to prevent the combustion of engines of war. The other opinion, however, recoiling from the idea of associating a corporation of tailors with those of the smiths, foresters, etc., takes it that the centonarii were simply roofers whose work of tiles or of shingles had more or less the aspect of that "cento" or patchwork whose name was given to the corporation. (See for the two interpretations, Rabanais, Recherches sur les dendrophores; Serigny, Droit public et adminis. romain, t. II., p. 336; Wallon, Hist. of slavery, etc.)

Perhaps the word which in Greek corresponds to the centonarius of Latin will help to settle the question. There is found in the MS. of the ἐμπειρίματα of J. Pollux, which was discovered by M. Boucherie, to whose kind favor I owe my knowledge of it, (κεντρωνοράφος) centronarius (sic). This translation seems a conclusion in favor of the first hypothesis.

However that may be, it is easy to perceive the reason that led the Romans to group together the four principal professions we have just cited. The ancient authors speak of a corporation formed to guard against fires, though the inscrip. make no explicit mention of this corporation. Pliny (Epist., Lib. X., ep. 42 and 43) proposes to Trajan the creation of a colleg. fabrorum for this object, and how could this corporation be better recruited than from the smiths, the carpenters, the navvies, and from the centonarii, whether these last were roofers or makers of the "centos" that protected the engines of war from fire? May this not be the origin of the grouping together of all these artisans and the explanation of their privileges? Sometimes the dolabrarii and the scalarii were joined with the centonarii, which would seem to furnish a further argument in favor of our opinion, which has, furthermore, the support of the authority of Heineccius (de Orig. et juve coll. et corp.).

4th. We will recall, in terminating this list of the corporations, those we have designated as calcis coctores, who prepared the lime for public works, and the vecturarii and naviculatii, who did the transporting.

Above, and probably outside of these corporations, we find the heads who directed the public works, of whom the principal ones were: —

The curator operis (Orelli, 24, 1506, 2273, 3264, 3265, 3382, 4011), who had the general direction of the works, and who, once they were accepted (opere probato) took on himself the entire responsibility; it was with the curator alone that the State had any dealings. (Dig. Lib. L., tit. X. l. 2, § 1.)

The contractor (redemptor, or locator operis) of whom we have previously spoken; it seems, from the Digest, where his duties are fixed, that his functions were those of a subordinate to the curator. "The curator is responsible to the State the redemptor to the curator."

The mensor ædificiorum (Orelli, 3223); the name of the profession and the instruments for measuring engraved on the tomb of one who followed this profession are the only indications we have of its duties.

The architect, the technical overseer — who did not, however, always correspond to the architect of to-day, for the ancients, and particularly the Greeks, sometimes gave the name of architect to the contractor (Bockh: Die Staats-haushaltung der Athener, Liv. II. Cap. X. and XIII.).

Finally, at the other end of the scale, far below the ordinary conditions of the corporations of artisans, was all the class of men who provided the material for public works, and who were placed by a closer dependence on the State in a condition but little better than slavery, the metallarii (Cod. Theod., Lib. X., tit. XIX.). These not only worked in the mines, but, with the convicts, quarried the stone to be used in construction. (See constit. No. 8, etc., of the tit. cited.)

[1] I have previously endeavored to state exactly the degree of uniformity that is to be found in Roman art, as well as the importance of the local deviations.

This uniformity, which, in spite of the shades of difference, dominated the whole system, came from the influence of the examples of Rome; and furthermore, from the control exercised over the works executed by the corporations of the provinces by the agent appointed by the central administration. The emperors gave to the constructions of the municipalities a curator whose functions were more or less well defined according to the period, but who seems to us to represent, to personify, the intervention of the emperors in the provincial works. Nothing leads us to believe that each work of public utility had a curator thus appointed by the emperor; but at least a large number of undertakings were directed in this manner, and it is most probable that this control on the part of the central power was not without influence in establishing common methods in the different provinces. This was particularly true about the time of Hadrian.[2]

Later the curator tended to lose his character as an agent of the emperor, to assume that of a municipal magistrate; and, finally, towards the last days of the empire, his office became one of those overpowering dignities that were imposed on the rich inhabitants of the cities, from which an exemption was considered as a special benefaction of a munificent prince.

Apart from this general direction given to the great works, there was another influence that tended to establish uniformity of methods throughout the empire; this was the participation of the legions in works of public utility. The Roman troops were regularly employed in building, and either alone or with the corporations of workingmen worked on the municipal monuments. Vegecias insists on the organization of a certain corps with this view: "The legion," says he, "includes carpenters, masons, wagon-makers, painters, etc.," and a law allowed the employment of these soldiers on public works, only forbidding their employment in private constructions. Another portion of the law authorized the proconsuls, in case of necessity, to place the troops at the service of the curator operum for the construction of temples and other public buildings. "Ministeria quoque militaria, si opus fuerit, ad curatores adjuvandos publicis dare."[3]

As for the application, the epigraphic texts not only show us the legions assisting in the erection of public buildings, but also represent them as being occupied in quarrying the stone or making the bricks to be used in provincial works. On every page of the collection of the inscriptions of the Rhine are to be found marks of bricks that recall the corps that made them. Sometimes only the number of the legion or of the vexillatio is placed on them; sometimes one can read on them even the names of the workmen (figuli) or of chiefs of the military workmen (magistri figulorum) who prepared them.[4]

[2] It will be recalled that Hadrian had the first idea of registering the artisans of the empire. It was he who appointed the curators to the baths of Venusia and of Benevento (Orelli, 3263, 3264); and it was he who imposed the quinquennials on certain building corporations (Orelli, 2163). No ruler seems to have mixed himself up in the details of construction in the provinces as much as this emperor-architect.

[3] Organization of the legion in view of works of construction.
Veget., Lib. II., Cap. XI.
Prohibition against placing soldiers under the orders of private contractors. Digest. Lib. XLIX., tit. XIV., l. 12, § 1.
Troops put under the orders of the curators operum pub. by the proconsuls. Digest, Lib. I., tit. XVI., l. 7, § 1.
In this case the cost of supporting the troops was placed on the province for whose profit they worked. This fact is known from a sentence of Philo (adv. Flacc., p. 966), where the author shows us the system by citing the abuses to which it gave rise. It is also indicated in some inscriptions that can be found in the résumé of the Corps. Inscrip. græcorum, Vol. III., p. 314 (Inscrip. Ægupt., Introd.).

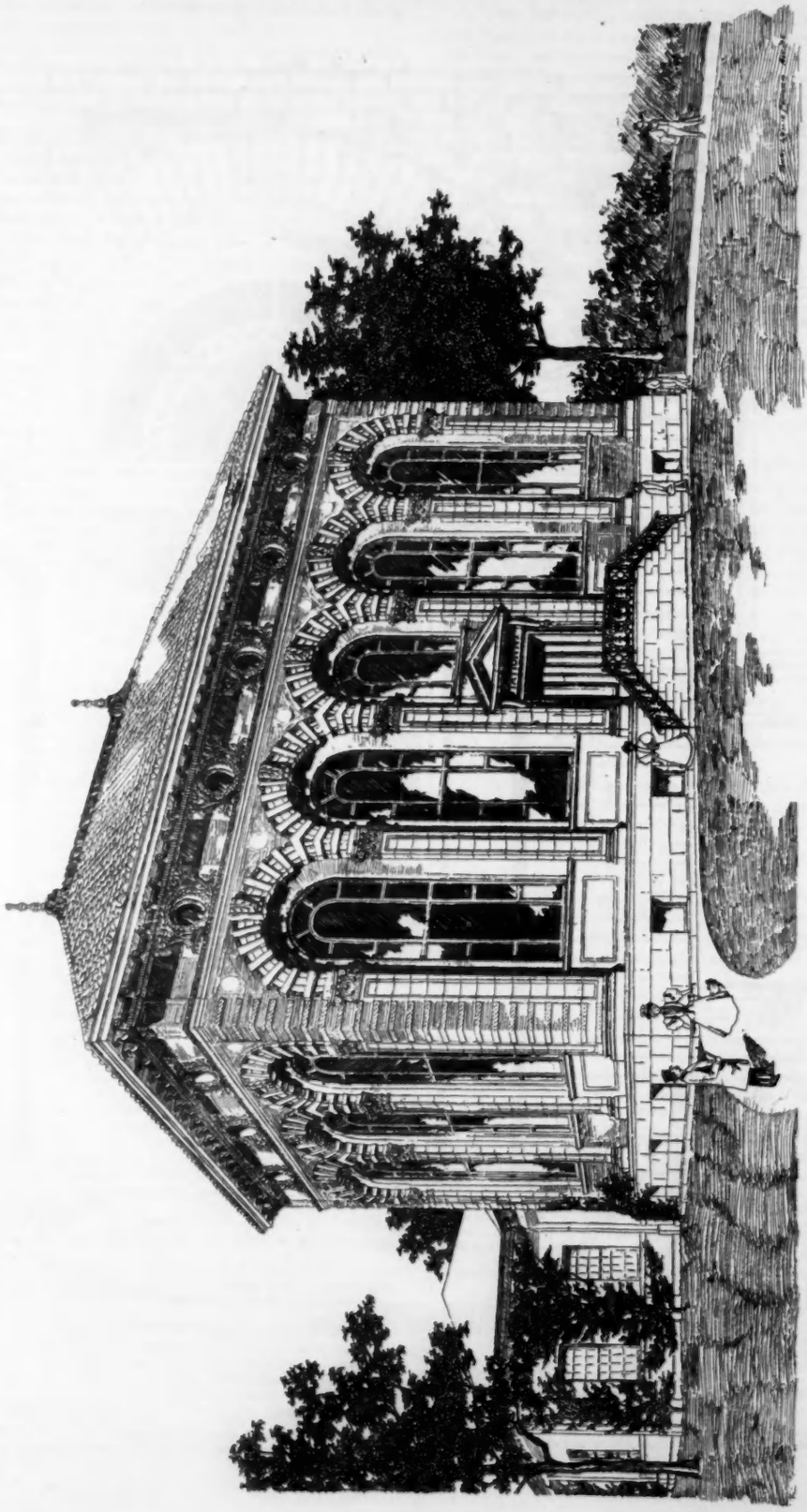
[4] I owe all these indications to M. Fr. Ritschl, who kindly pointed out, among the documents of his collection of Inscriptions of the Rhine, the following:—

1st. Stone quarrying by the legions;
Corpus Inscrip. Rhen. No. 651 et seq.

2d. Brickmaking by the legions:
Corpus. Inscrip. Rhen. No. 223, p. 63, i, 2.
Mention of the vexillationi who aided in the brickmaking.
Corpus. Inscript. Rhen., p. 118, d. 3.
Names of figuli and magistri figulorum, belonging to the army.
See the list drawn up by M. Brambach; Corpus. Inscrip. Rhenan., p. 380.

3d. M. Ritschl thinks that the Inscrip. of the Corpus Inscrip. Rhen. under the number 1397, and the three inscrip. 837, 1548, 1554, are relative to the works executed by the troops.

COLONIAL DOORWAY, HARRISBURG, PA.



WATER POWER HOUSE, INDIANAPOLIS, IND.
KIMBALL & THOMPSON, ARCHITECTS.

Fire-proofing Department.

FIRE-PROOFING UNDER FIRE-PROOFING LAWS.

THE ideal condition of architecture and structural practise would be one which is in the hands of competent, trained architects and builders, who so thoroughly understand their business, and whose integrity is so above question that municipal regulations would not be needed for their direction and control, but each problem as it arose would be solved in the best manner for the particular case, and intelligent preconceived judgment would take the place of the arbitary and often irrational laws which, because of our human limitations, are necessarily imposed upon the practise and the theory of building. Laws which, of themselves, may in a general sense be commendable, are not always applicable, and there are crudities and even absurdities in all of our municipal regulations which, so far from attaining the object sought, — namely, a production of the best kind of work, — often through the ignorance of the law makers, if not through the carelessness of the executives, will produce a directly opposite result. This is especially true, we are sorry to say, in regard to the specific statutes which are intended to regulate, define, and limit the use of the so-called fire-proof construction.

Every architect and builder knows what first class fire-proof construction is. We all admit that iron is absolutely worthless for structural purposes unless perfectly protected against intense heat. We theoretically know and practically admit that very few mediums are efficient to properly protect the steel; and while a number of materials have been tried with varying success, the choice is limited within very narrow bounds. We make experiments which determine just how far much material can be trusted; we know just what should be done for theoretical cases; and yet in probably every large building which is put up in our principal cities there are weak points in the construction, or more properly in the fire-proofing, which the law allows and even sanctions in some cases, and yet which no one, if put to the direct question, would for a moment claim to be efficient or even intelligent. One reason for this arises from the workings of the contract system. The architect is expected to decide in advance every detail of the construction, and no individual architect has yet arisen who is sufficiently all-knowing to include everything. Then, in estimating, the builders are obliged to figure as closely as they can. The builder cuts prices with the fire-proofing contractors, the iron worker cuts with the fire-proofer, the general contractor cuts with the whole of them, and the owner keeps up with the procession by crowding down the general contractor. Then when the building by any chance is caught in a serious conflagration and is partially or totally destroyed, we say that another fire-proof building is gone wrong, and we hold up our hands in structural horror at the blindness of such and such architect, or such and such builder, to permit such scant fire-proofing, when, perhaps, in the very next building we will do just as badly ourselves. We are too inclined at the present period to consider cost before efficiency. The fire-proofing is hid away from view. After it is neatly plastered over no one can tell what is inside; the odds we assume are one hundred to one that the building will never be burned down, and we take our chances, fortunately, with a very large degree of impunity. In these days of the wide dissemination of knowledge through books of all sorts there is no excuse for any architect or builder being ignorant of proper methods, and the practical theories of fire-proofing as applied to large buildings, but we unfortunately encourage cheapness rather than excellence. Too many of our architects will bank their reputation on the stability of an important structure upon the remote chance of the building catching fire, and will not be particular enough to insist upon the very best for that part of the work which is never seen, is little appreciated, and is often not understood at all by the man who pays the bills. There is altogether too much chance entering into much of our fire-proofing. In these pages we have repeatedly emphasized the value of burnt clay as a fire-resisting medium. We cannot afford to take very many chances when so much is at stake, and when we know a material will resist a high degree of heat it behooves us to be very cautious in tolerating anything else.

Any one who has passed by a building in process of erection cannot have failed to be struck with one or two weak points which seem to be neglected. One very frequent lapse of this kind is in the so-called fire proofing of external steel beams and columns. According to the laws of the city of Boston, which, by the way, are much less exigent than those of some other cities, one inch of ordinary plaster is accepted as sufficient protection for any structural steel work. We will not undertake to discuss the fire-resisting qualities of an inch of plaster; but the so-called inch becomes in many cases barely one sixteenth as actually applied, and we have repeatedly noticed instances where a coarse mesh of iron wire will be stretched over an iron beam and a rough coat of plastering applied thereto, the plastering being so thin and crowded so closely against the iron that every mesh of the netting is visible in the finished plaster. And yet this passes as a fire-proofing of the iron beam, when, as a matter of fact, it is doubtful if a beam so protected would last five minutes in an ordinary conflagration.

We know of one instance in a city not more than a thousand miles from Boston where the theory of fire-proofing was carried to even a more absurd extent. A certain manufacturing company desired to build an iron truss over its engine room. The statute in this particular city distinctly stated that all structural metal work must be protected in specific ways; but in another part of the building law there was a clause which recognized the value of so-called fire-proof paint, and by virtue of this latter ambiguous clause the builder was allowed to simply paint the ironwork of the girders with one of the whitewashes which passes for fire-proof paint, and the work was then accepted and passed by the local inspector as being thoroughly fire-proof. This is, of course, an extreme case; and yet in buildings of the first magnitude and importance we have seen steel columns intended to support loads running as high as six and seven hundred tons, which were protected only by a thin enclosure of expanded metal and Windsor cement, which formed both the fire-proofing and the finished plaster work, and was so scanty in places that a lead pencil was inadvertently punched through the wall and through the fire-proofing. When the building was finally inspected it was found that the enclosure ran only to the floors, and on account of some furring on the ceiling below there was ample chance for a draft of fire being carried up in the construction of the column itself in such manner as to convert the angles of the column into what might easily become a blast furnace.

The fact is, that notwithstanding the many substitutes which have been devised and advocated on the score of economy, there has nothing yet been found on the whole so satisfactory, so efficient, and so stable in its preserving qualities as terra-cotta. Not terra-cotta one half an inch thick, run out in thin slabs and deeply grooved at that, and then stuck up against an iron column with a little plaster of Paris, but a good, generous envelope of burnt clay, thick enough to act as a real insulator, solid enough to bear considerable jarring, and secured in place so strongly that the force of a jet of water from a steam hose will not dislodge it and break down the protection. We imagine that nine owners out of ten, if asked whether they could spare the space equal to four or five inches on the outside of all the flanges of isolated steel columns in the first story of a building would anxiously say no, that the space was too valuable, and that fire-proofing must be devised which would not take up so much valuable space. But it is the province of the intelligent architect and builder to decide these questions, not on the score of economy *per se*, nor of renting space alone, but to make his fire-proofing, like Cæsar's wife, beyond suspicion. The lesson of the Pittsburgh fire is that it is perfectly possible to protect steel in a most efficient manner, and we cannot afford to take possible chances when it is so easy to make sure. An investor, a real estate owner, will very naturally economize in the construction in the hidden parts of a building to almost any extent

to which an architect will let him, sometimes this economy resulting from ignorance, but quite as often from deliberate intent to take advantage of a law which is framed in ignorance and allows only too many loopholes for inefficient construction. But we believe that every one would be better satisfied in the long run if our architects and builders would take the stand that they would not for one moment countenance experiments in fire-proof construction except when the experiments are conducted simply for their own sake; that in a large modern building the fire-proofing above all things must be of the best; and fire-proof paint, a light skimming of plaster or a thin furred plaster wall around the column, while having a purpose and perfectly proper under some conditions, are totally inadequate as a fire resistant. The best is none too good. We have never been able to reach perfection in this most uncertain of the applied building sciences, and the architect or builder who lends himself to the employment of anything than that which he knows is going to stand the most severe tests is imperiling his own reputation, is preparing the way for a possible catastrophe, the evil results of which can hardly be measured, and though he may be acting for the seeming benefit of his economical client, he is really doing just the reverse. In construction the architect must take the ground that he knows more than the investor, that he himself is the arbitrator of what shall be done, and he should make it his rule always to give his client what he really wants rather than merely what he thinks he wants. And, beyond this, our laws relating to fire proofing should be rigidly revised by those who know more about the subject than the average lawyer or legislator.

We have sometimes had a Utopian dream, which at the very outset is admittedly impracticable, and yet which is fascinating by its simplicity, and that is to abolish off hand all building ordinances which relate to the use of materials, strength, protection, etc., and instead of spreading the shield of the law over doubtful interpretations and questionable local practises, to put the whole responsibility for the success or failure of every building, where by right it belongs, on the shoulders of the architect, holding him to the strictest accountability, and compelling him by severe penalties to build in accordance with what in ninety-nine cases out of one hundred he knows is right. Unfortunately, so long as architecture is an open profession, such a condition of affairs is impossible, and we can only hope that the repeated severe lessons, which we have at times presented to us, may be the means of a surer appreciation and a more thorough application of the fundamental principles of fire-proof construction. We cannot afford to continue to send up millions in smoke, when a small percentage of those same millions, if judiciously expended, would make our buildings impregnable.

FIRE-PROOF CONSTRUCTION.

ONE probable result of the increased duty upon lumber will be to increase the number of buildings put up of absolutely fire-proof construction. With this form of building material on the free list, the gradual reduction in the cost of steel beams, terra-cotta, tiles, bricks, and other non-combustible materials has been sufficient to make the cost of an ordinary building hardly more than 10 per cent. greater, if of fire-proof construction, than if put up in the old-fashioned way. But if lumber of all kinds is to have its price increased, as seems probable, by these tariff changes, then it is not unlikely that even this difference will be reduced, so that it may, in a short time more, become absolutely cheaper for a person putting up a brick or stone building to have the interior built in an absolutely fire-proof manner, than it will to have this same interior constructed of wood. As to the duration and to the cost of repairs, the advantages are all on the side of fire-proof construction, while the added space obtained is of itself almost enough to justify the change. In the matter of speed of construction, recent experience has shown that a modern fire-proof building can ordinarily be put up in about two thirds the time required to construct one of the old-fashioned type.— *Boston Herald.*

Mortar and Concrete.

LIME, HYDRAULIC CEMENT, MORTAR, AND CONCRETE. VII.

BY CLIFFORD RICHARDSON.

THE ROSENDALE CEMENT INDUSTRY.

TREATMENT OF BURNED STONE.

THE burned stone, as drawn from the kilns, is carefully sorted in order to reject any partially fused clinker or underburned portions. In a carefully conducted works there is but little of such material, yet always enough to require careful attention. It should, of course, be rejected because of the injury it would do to the quality of the ground cement, but it is probably oftener thrown out on account of the difficulty of grinding it, because it is so much harder, whether over or underburned, than the properly burned stone. With some rock, free from magnesia, the overburned material is ground by itself and sold as natural Portland cement.

Depending on the character of the original limestone, the burned stone may go immediately from the kiln to the mill for grinding; or if it yields a fiery and too quick setting cement, as many of the limestones free from magnesia do, it must either be sprinkled or steamed to make the cement slower setting. The object is to slake the excess of free lime, which would, in the course of making a mortar of the ground cement, raise the temperature so much as to cause a too rapid set. This result can also be accomplished by air slaking the ground cement, but such a proceeding requires very considerable storage facilities and much time. It is, therefore, more expeditiously brought about by treatment of the burned stone before grinding.

For sprinkling a water-pot is used, and a measured quantity of water is carefully dirtributed over the lumps of burned stone as it comes from the kiln. The amount necessary for different stones must be learned from experience. It is usually from one to two gallons for each ton of the burnt material.

For steaming, the burned stone is dumped into a hopper, or bin, with shelving sides, where it is exposed to the vapor from steam which enters at the bottom. Such a bin may have a capacity of from 2,500 to 3,000 barrels of cement. The burned rock after a suitable time is drawn off and treated like that which has been sprinkled.

On reaching the mill it is crushed coarsely in any of the ordinary forms of rock crusher, or with a spalling hammer. It then goes to one of the many forms of crackers, or pot mills, where it is reduced to the size of peas, or finer. At this point it may be screened or sent to the buhrs, or mills, direct. The former process results in a much increased capacity for grinding. The fine powder, which is removed, amounts to about 25 per cent. of the stone, and is, of course, conducted to the receiver containing the ground cement from the mills, and again carefully mixed with it by means of worms. The coarser stone, or the entire run of the crushers, goes to the grinding apparatus, which commonly consists of buhr stones in their many forms. Although they need frequent redressing, every two or three days, stone mills have been found more economical for grinding such a soft material as burned limestone, than any of the forms of mill used for Portland cement. One run of stone, depending on its size and the degree to which the grinding is carried, will take care of from 200 to 150 barrels of cement per day of ten hours.

It is now customary to grind much finer than several years ago, so that as much as 94 per cent. of a high-grade cement will pass a sieve of 100 meshes to the lineal inch. The increased cost is found to be fully repaid in the improvement in quality of the product.

The best Rosendale brands now sift as fine as, residue on 200 mesh sieve, 10 per cent.; on 100 mesh, 6 per cent.; on 50 mesh, 2 per cent.; but ordinary natural cements average 15 per cent. on the 100 mesh sieve.

From the mill the ground cement generally goes to a large warehouse or bin, being thoroughly mixed on the way, so that there shall be no segregation of the harder and softer or coarser and finer particles. From storage it is drawn off by special apparatus and packed in either barrels, coopered near at hand, or in bags. The cement is compacted in the barrels by a shaking machine, or jig. The amount is carefully weighed to 300 lbs. in Ulster County, N. Y., and on the Potomac, but in the West it frequently falls as low as 260 lbs., owing to the smaller volume weight of the Western cements. When properly labeled with brand and date of packing it is ready for the market.

PHYSICAL PROPERTIES AND CHEMICAL COMPOSITION OF NATURAL CEMENTS.

Color. The numerous natural cements of the United States differ in appearance very decidedly, varying in color from the very pale and light buff of the magnesian Potomac and some Western cements, through a gray color, resembling Portland, to the dark brown of the Rosendale brands. The color is due to the oxides of iron, manganese, etc., and the varying proportions and forms in which they are present. The value of the material as a hydraulic cement is not, however, at all affected by its color.

Specific Gravity. The specific gravity of natural cement varies with the rock from which it is made; the denser the rock, the denser the cement. Some well-known brands have the following specific gravities:—

Brand.	Rock.	Cement.
Rosendale	2.84	3.04
Round Top	2.73	2.84
Minnesota	2.74	2.81
Fort Scott, Kans. .	2.72	2.79
Utica, Ill.	2.67	2.70

These specific gravities are, however, for freshly burned cement. If cement has been exposed for some time and absorbed water and carbonic acid its specific gravity becomes much less, falling in one case from 2.84 to 2.57 after a year.

Weight. The volume weight, or density of a natural cement may be roundly expressed as 1.28, water being unity, when packed as ordinarily found in the East in barrels of 3.75 cu. ft. capacity and 300 lbs. weight. A cubic foot in this condition weighs 80 lbs., and a struck bushel 100 lbs. With cements not so dense 300 lbs. may require a barrel of considerably larger capacity and the volume weight be considerably less. When very coarsely ground all cements will, of course, weigh more per given volume than when fine.

COMPOSITION AND PROPERTIES OF NATURAL HYDRAULIC CEMENTS.

From what has been already said of the variation in the composition of the hydraulic limestones in different localities, and even in the same quarries, it is evident that great difference in the composition of the resulting cements and in their properties must exist as well, and that there is no such uniformity in their composition as is the case with Portland cement. That this is so appears from analyses, which are given in the following table, of most of the well-known brands of natural cements, as they are found in the market.

	Lime. CaO	Magnesia. MgO	Silica Comb. SiO_2	Alumina. Al_2O_3	Iron Oxide. Fe_2O_3	Soda. Na_2O	Potash. K_2O	Sulphuric Acid. SO_3	Loss on ignition. CO_2+H_2O	Silicates undec.
ROSENDALE.										
Hoffman, 1897	34.64	14.82	16.49	10.96	4.68	.55	1.25	1.04	4.50	12.42
Hoffman, 1890	35.84	14.02	18.38	15.20				.93	3.73	11.46
Hudson River	36.67	14.35	18.17	11.30				1.32	4.27	13.11
New York & Bridge	33.18	19.61	11.28	9.40					4.40	14.64
Newark & Rosendale	34.14	19.61	24.43	8.68		.23	1.39		3.57	6.35
Rock Lock	35.35	14.75	14.82	17.50				1.41	4.68	12.18
NEW YORK—WESTERN.										
Akron Obelisk	37.54	26.14	13.94	10.02		.52	1.60		4.58	6.81
Star	41.60	22.24	16.20	4.40	2.80	.23	1.39	2.06	6.90	4.00
Buffalo	39.20	26.52	13.24	4.40	2.00	.41	1.44	1.39	6.80	3.24
PENNSYLVANIA.										
Siegfried	45.95	11.53	5.78	6.86				.69	26.17	13.83
Milroy	41.90	29.73	13.56	5.00				.74	6.40	4.68
WESTERN.										
Sellersburg, Ind. Anchor.	38.28	11.94	18.52	4.78	3.24			1.97	10.39	6.24
Milwaukee	33.40	22.60	13.80	4.00	2.80	1.64	.87	2.59	9.50	11.20
Louisville	46.64	12.00	20.42	4.76	3.40			2.57	6.75	3.74
Utica, Ill.	29.99	19.79	9.58	2.76	2.16	.26	1.51	1.35	15.96	17.42
KANSAS.										
Ft. Scott	49.80	12.16	17.60	4.00	5.00			2.04	4.50	4.20
MINNESOTA.										
Mankato	45.51	15.02	16.30	3.34	3.80	1.33	.70	1.94	10.00	5.06
POTOMAC.										
Shepardstown	34.83	11.33	22.89	9.36			1.25	1.49	5.13	13.62
Antietam	29.38	13.37	14.54	10.44	3.25			1.15	7.15	18.96
LIME CEMENTS.										
Round Top	45.66	2.86	21.68	8.34	4.14			1.31	8.13	7.96
Cumberland & Potomac	39.54	3.80	20.42	8.38	5.38				10.20	9.80
Cumberland	41.96	3.19	20.25	14.76					7.97	9.41

Among these cements the following extremes of composition are to be seen:—

	Total Lime and Magnesia.	Lime.	Magnesia.	Silica combined.	Alumina.	Iron Oxide.	Soda.	Potash.	Sulphuric Acid.	Loss on ignition.	Silicates undec.
Highest	65.84	49.80	29.73	24.43	10.44	5.08	1.64	1.60	2.59	26.17	17.42
Lowest	42.75	29.38	2.86	5.78		4.92	.23	.87	.93	4.20	3.24

The differences are very great. If, however, the inferior brands are excluded and only those considered which are standard, such as Hoffman Rosendale, Milwaukee, Louisville, Round Top, and Fort Scott, the following figures are obtained:—

	Total Silica and Magnesia.	Lime.	Magnesia.	Silica combined.	Alumina.	Iron Oxide.	Sulphuric Acid	Loss on ignition.	Sand.
Highest	61.96	49.80	22.60	21.68	15.20		2.59	9.50	11.46
Lowest	48.52	33.40	2.86	13.80	4.00	2.80	.93	3.73	3.74

Among these standard brands there is still, however, a great diversity of composition, and each seems to be more or less a type in itself.

The results of these differences in composition, of course, affect the hydraulic value and other physical properties of the cements.

THE USE OF WET SAND IN THE MAKING OF MORTARS.[1]

BY P. HERVIEU.

THE influence of the degree of dryness of sand upon the setting of mortars is well known; it suffices to say that, without having any very serious effect upon lime or slow-setting cements, wet sand can, with rapid-setting cements, retard the setting by inducing the formation of aluminate of lime. Otherwise, the resistance of mortars does not appear to be diminished, to judge from the experiments of Candlot.

More or less water in the sand used has another consequence, equally well known, but which has not received the attention that it merits; *i. e.*, the difference of volume which exists between dry and wet sand.

The following table gives the results of experiments made by Candlot.

Kind of Sand.	Weight of 1 Liter of Sand Measured without Packing.		Loss of weight due to humidity.	Observations.
	Dry.	Wet.		
	Grams.	Grams.	Grams.	
Rounded Quartz Grains.	1418	1170	248	Average sand: grains pass through No. 20 screen (19 meshes to an inch), and remain upon No. 30 (28 meshes per inch).
Angular Quartz Grains.	1300	1019	281	Mixture of six sizes of sand passing through screens No. 50, 30, 20, 12, 6, and 2.
	1560	1148	412	

[1] Translated from *Nouvelles Annales de la Construction*, August, 1897.

This is for average sand; it increases to 300 grams for very fine sand, and descends to 25 grams for large particles; the maximum was attained with a mixture of different sizes.

These diminutions in weight are naturally accompanied by a proportional increase in volume; thus, in the examples in the table, the volume of wet sand increased $\frac{1}{21}$th, $\frac{1}{27}$th, and $\frac{1}{35}$th, of that of the dry sand; inversely, the dry sand is 0.825, 0.784, and 0.736 of the volume of wet sand.

These results have been confirmed by experiments which we have made and which it is easy to repeat:

1. A liter of river sand thrown upon a platform in the ordinary condition of wetness, exposed to the sun, was reduced, after apparently completely drying, to 0.782 liter.

2. A liter of the same sand, dried upon a heated iron plate, was reduced to 0.761 liter.

These figures approach quite closely to those of Candlot.

Variations in volume increase for the same sand with the degree of wetness up to a certain limit only; in fact, it diminishes when the sand is soaked and disappears when the sand is entirely immersed.

We will not attempt to explain these facts, as such discussions will be found in all works on the subject, but we will show the effects by an example.

Suppose a cement mortar is to be made composed of 300 kg. per cubic meter (500 lbs. of Portland cement per cubic yard of sand) mixed in a box graduated to secure this proportion (generally it is more convenient to mix half this quantity of mortar). The volume of dry sand will be exactly 1 cu. yd. and the proportions exact; with wet sand the real volume will not be more, but by reason of the moisture there will be less dry sand, making the relative proportion of Portland cement 394 instead of 300 kg. per cubic meter (650 instead of 500 lbs. per cubic yard of sand). It will hence be necessary to take $500 \times 0.782 = 390$ lbs. of cement to add to the wet sand, a difference of $650 - 500 = 150$ lbs., which at 64 cents per 100 lbs. (price at Paris) corresponds to an extra expense of 96 cents per box of mortar. Lime and cement can be readily weighed before mixing, but it is inconvenient to weigh the proportions of sand.

On the other hand, river sand, which is more frequently used, is often brought directly by boats from where the dredge had taken it; it is hence very wet when placed in the mortar boxes, and to obviate this by artificial drying is not to be thought of.

It is a question as to whether dry or wet sand should be considered as the type. It is doubtful whether dry sand alone can be considered as such.

The proportions adopted in each case for mortars is fixed by the results of tests made on small specimens. To compare these tests in order to arrive at definite conclusions, it is necessary to use material not only identical in nature, but in the same physical condition also at the time when it is used; that is to say, the sand should not be taken for this purpose as it comes, but should be dried in such a manner as to render the samples as nearly uniform as possible, in order to be able to evaluate their influence correctly in the finished briquette.

Then a mixture of 500 lbs. of cement to 1 cu. yd. of dry sand would be considered as the normal, and it would simply remain to find what proportion of wet sand should be used. The most simple method of doing this is to shake up the sand measure in such a manner that the wet sand will be of the same volume as dry sand; this cannot be done exactly, but the difference will be small. One liter of sand, the same as was used in the preceding experiments, has been brought by shaking to 0.808 liters, exceeding sun-dried sand by 0.018 liters. But such shaking up or settling is not possible on all public work, and the measuring devices are not adapted to it. It has, however, been thought well to call the attention of engineers to this fact in order to prevent serious mistakes in proportioning mixtures. No rule could be made which would be universally applicable, but each one must use his own judgment and experimental data. If it is important that a definite mixture should be specified, it is equally so that methods be employed to carry out the specifications rigidly.

PRODUCTION OF HYDRAULIC CEMENT IN 1896 IN THE UNITED STATES.

THE reports upon the production of Portland and natural cements in the United States in 1896, by Spencer B. Newberry and Uriah Cummings, for the Annual Report of the Director of the Geological Survey for 1896–97, Part V., Mineral Resources of the United States, have been recently made public, and contain much information in regard to our cement supply that is of interest.

The production of American Portland cement reached 1,543,023 bbls., in 1896, as compared with 990,324 in 1895, an increase of nearly 56 per cent. over the previous year. This increase was most marked in the Lehigh Valley region, the largest producing center in the country, where five plants yielded 1,048,154 bbls., or 68.1 per cent. of our entire supply, as compared to 485,329 bbls., or 61.2 per cent., from the same source in 1894. New York and Ohio were the only other localities where a steady and considerable growth occurred, the remainder of the country showing a decline.

The imports of Portland cement were 2,989,597 bbls. in 1896, which is a slight decrease over those of 1895, but the amount imported annually during the past six years has been very uniform. Over 40 per cent. of the imported cement was German, the proportion having gradually increased, with a diminution in the amount received from Great Britain, owing to the increased appreciation of the character of the German cements, and the more careful methods employed in the German factories, the English manufacturers clinging, until very recently, to the old methods, and being, in consequence, not up to modern requirements.

The imports of Belgian cement were equal to those of English brands, but their character was inferior. They consist largely of so-called natural Portland cements made by burning, at the temperatures usually employed for the production of Portland cement, a natural hydraulic limestone which approximates the composition requisite for a high-grade Portland cement.

The production of Portland cement in the United States was, in 1896, 34.7 per cent. of our entire consumption, where it was only 13.2 per cent. in 1891, and 25.3 per cent. in 1895, so that, while the importations have not increased, the factories of this country have tripled their output. The prospects of the industry, therefore, seem to be good, especially as the high character of the best brands is recognized. The price of American Portland is, however, much below that of the imported article, with the duty included, owing to the sharp competition among the leading manufacturers, so that a difference of price at from 30 to 50 cents per barrel between the two may occur.

By far the largest amount of American Portland cement is made from limestone, eighteen factories using this substance as compared to eight which use marl, while the use of rotary furnaces, instead of vertical kilns, is also increasing relatively.

Attention may also be called to the fact that our markets, probably in response to a demand for cheap cements, is filled at the present time with very inferior second and third grade material, which is called Portland cement, and which consists of either overburned natural cement rock, improperly burned cement clinker, or some mixture, such as a good Portland cement intimately ground with a large proportion of sand or limestone, which, while in itself perfectly suitable for use under certain conditions, should not be sold as Portland cement and at a price which is relatively much too high.

The production of natural cement increased slightly in 1896, accompanied by a very slight rise in value. The total output is stated to be 7,970,450 bbls., of which Ulster County, N. Y., produced 3,426,692; New York State, 4,181,918; and Indiana and Kentucky, 1,636,000; while the output in pounds *per capita* of our population was 33.93 as compared to 13.04 in 1880. For much masonry, which was formerly laid with lime, natural cement is now used.

Attention is called by Mr. Cummings to the differences in the standard of weight in a barrel of natural cement in the East and West, in the former case 300 lbs. constituting a barrel, and in the latter 265 being considered one.

The Masons' Department.

SOME REASONS FOR ARBITRATION.

CONSIDERING the fact that almost every building contract contains a clause providing that, in case of difference of opinion regarding the value of extra work or work omitted the matter shall be settled by arbitration, it seems rather strange that we hear so comparatively seldom of disputes of this kind being adjusted in such a way. In discussing the difficulties attending the accurate valuation of work attention has been called to the fact that it is almost impossible for an architect to do better than approximate the cost of labor and materials, and the results which he obtains, it must be admitted, are often unreliable and inaccurate. What the architect wishes to determine in cases of dispute over the value of work is what is fair and reasonable, but under existing conditions it seems practically impossible for him to obtain such information, for the simple reason that he cannot get at the bottom facts. The natural conclusion to draw from such conditions is that contractors are unwilling, as a rule, to let an architect know the true value of work and materials, which, in turn, shows one of two things; either that the contractor feels that the architect will misuse such information if he is allowed to have it, or that the contractor, for certain reasons, does not care to have it known where his profit is made. After making all due allowances for the shortcomings of the profession, it can hardly be claimed that the first-named reason is a just and valid one. On the other hand, it is usually admitted by a contractor that his profits are both irregular and uncertain; that is to say, while the totals on a given piece of work may be very close, detailed estimates would show wide variations. While such a state of things exists both architects and contractors must work more or less in the dark so far as their knowledge of the actual value of certain work and material is concerned. The way to have such matters definitely determined is to have a certain number of experts, with opportunities for knowing all the facts of the case, sit down together and, after a discussion of the question, both in general and detail, figure the cost of the work individually, and after a comparison of the different results, agree finally on a certain definite sum as representing as nearly as possible the true value of the work and materials. After a certain number of cases had been settled in this way, they would constitute valuable precedents which could be referred to as a basis for setting a fair price on similar work. It is true that, as no two buildings are alike, the cost of the labor and materials necessary to perform a given piece of work varies also. But with a reliable unit to start from, it is comparatively easy to approximate with a considerable degree of accuracy the value of work which is similar in character to that of which we have a precise and definite knowledge. There seems to be a decided inclination on the part of contractors in this country to keep from the architects the true cost of the various things which enter into the construction of a building. As has already been stated, unless there is reason to believe that the architect will misuse his knowledge of prices, there is really nothing to be gained by keeping him in the dark on matters of this kind; for, without any definite basis upon which to found his opinion, he naturally inclines to under rather than over estimate values, and, of course, the contractor suffers to whatever extent this is done. To show that the architect can be trusted with a knowledge of prices we need only to refer to the English practise, where, before a contract is signed, the builder is required to deposit with the architect a detailed bill of quantities with the prices for each different kind of work and materials stated. Attention has been called to the fact that if contractors could be compelled to depend on what may be called legitimate profits, building contracts would be awarded more fairly than at present; for upon this basis an estimate would include the fair profit to which the builder is justly entitled, and he would not dare to run the risk of taking the work at cost or less, and depending on changes for which he can charge a price wholly out of proportion to the true value of the work.

Unless we can introduce the English method of estimating, which seems for the present impossible, the only way for the architects to learn definitely the value of work and materials is in the line of arbitration. In point of fact it would seem desirable in many ways to have some permanent board of arbitration, under the control of the architects' and builders' associations, whose duty it should be to settle all disputed claims arising between members of either of these bodies.

HOW TO BUILD A CHIMNEY.

THERE are floating through building literature a thousand and one remedies for curing smoky chimneys, but very few methods suggested of "how to build a chimney that will not smoke." This, of course, is a pretty difficult task, particularly if the chimney is placed in a multi-gabled house, or near other buildings, trees, or hills. Yet fairly good results can be obtained by the scientific builder if he follows certain given rules. If a chimney is intended to carry smoke from an open fireplace it is a good plan to make the throat not less than 4 ins. wide and 16 ins. long, which will give an area at that point of 64 ins.,—of course something will depend on the size of grate,—then the flue should be abruptly enlarged so as to nearly double the area, and so continue for a foot or more; then it may be tapered off gradually until the desired area is obtained. The inside of the chimney should be "parged" or plastered throughout its entire length, and made as smooth as a trowel can make it, and the mortar used should be the very best so that it will harden with age. No flue should contain less area than 60 sq. ins. The best shape for a chimney flue is circular, or many sided, as giving less friction. Brick is the best material for the purpose, as it is a non-conductor. The higher above the roof a chimney rises the better. When expense is no object, 8 in. drain tile (glazed), built in the chimney, makes the best flue known, if properly jointed.—*Canadian Architect.*

THE ENGLISH METHOD OF BUILDING CEMENT SIDEWALKS.

EXCAVATE the ground to a depth of about 5 ins. below the finished level, and upon this lay about 1 in. thickness of cinder or gravel; upon this lay a layer of clean, hard stone, or other suitable material, broken so as to pass through a 3 in ring, well watered and rolled, filling up inequalities and leaving the surface about 2 ins. below the level of the footway (sidewalk). Divide into bays (sections about 6 ft. in width, with battens of soft wood), and complete each alternate bay by laying stone foundation carefully prepared concrete composed of one part Portland cement, two parts coarse, clean gravel, or other suitable procurable material, passed through a 1 in. screen, and two parts clean, sharp sand, which must be well beaten or rolled into place; and before it is set a finishing coat 1 in. in thickness of a finer and richer concrete to be added and brought up to the finished surface of the footway, and well troweled and smoothed into place. This finishing coat may be composed of one part Portland cement to two parts granite chippings, three parts gravel, or other suitable material, which will pass through a ¼ in. sieve. As the work is finished the battens may be removed and the joints filled with fine sand.—*Carriage and Footway Construction.*

THE LAW.

WHERE lots have been conveyed subject to a covenant that no buildings shall be erected on the same within a certain distance of the street, such covenant is enforceable, though the streets on which such lots abut has changed from a residence street to a business street.—*Superior Court of New York.*

WHERE a contract for the sale of real estate provides for a variance in the dimensions of the premises of one inch in width and depth, the purchaser will be relieved from the contract if the building on the premises encroaches more than one inch on the adjoining premises.—*Superior Court of New York.*

Recent Brick and Terra-Cotta Work in American Cities, and Manufacturers' Department.

NEW YORK. — Nothing of great importance has occurred during the past month in building and real estate circles, although the aggregate has been important enough to fulfil predictions of a prosperous winter, and places September among the successful months of the year. There appears to be no cessation to the building of homes in the metropolis, as the reports of building enterprises show. There seems to be an endless supply of apartment houses in the city for people of every class, and fortunately the demand is equal to it. After the first of January there may be many radical changes made in the building laws, owing to the new building department, which will have complete charge of the building interests of the greater city, according to the new charter. This event will be awaited with great interest by architects and builders especially, and we can confidently look for great improvements.

RESIDENCE, MORRISTOWN, N. J.
Built of mottled brick furnished by the Raritan Hollow and Porous Brick Company, 874 Broadway, New York City.

Cady, Berg & See, architects, have prepared plans for an interesting building to be used for public baths. The building will be three stories in height, of brick and terra-cotta. It is situated on Rivington Street, and $75,000 is to be expended. This venture will be considerable of an experiment for New York, but promises to be successful if popular interest and public opinion are any criterion. Great credit is due to the *Cosmopolitan*, which drew attention to the subject by a competition several years ago, in which the scholarly designs of Mr. John Galen Howard were placed first.

The most important large work in contemplation is the new home for the Geographical Society of New York, for which purpose a fund of $400,000 is already on hand. The site has not yet been chosen nor plans selected. Judge Charles P. Daly is president of the society, a position which he has held for the past thirty-three years. Its first president was George Bancroft, the eminent historian.

George Crocker, the Californian millionaire, has purchased the old Knickerbocker mansion, corner of Fifth Avenue and 64th Street, at a cost of $250,000. He intends making improvements which will cost as much as the site.

Louis H. Sullivan, architect, has drawn plans for a twelve-story office building to be erected at the corner of Bleecker Street and Broadway. Cost, $400,000.

Edward Wenz, architect, has planned two five-story brick flats to be built on 112th Street, near Lenox Avenue. Cost, $38,000.

R. H. Robertson, architect, has prepared plans for a four-story brick and stone dwelling for Mr. George Sherman, to be erected on 55th Street, near Fifth Avenue, at a cost of $65,000.

John Hauser, architect, has planned four five-story brick flats to be built on Madison Avenue near 101st Street. Cost, $100,000.

Henry Anderson, architect, is making plans for the new Lutheran church on 140th Street, corner Edgecombe Avenue. It will be a brick building, and will cost $60,000.

John Woolley, architect, has planned four five-story brick flats to be built on 67th Street, near Amsterdam Avenue. Cost, $72,000.

W. C. Dickerson, architect, has planned four five-story brick flats to be built on 117th Street, near Lenox Avenue. Cost, $80,000.

George F. Pelham, architect, has drawn plans for four five-story brick flats to be built on 103d Street, near St. Nicholas Avenue. Cost, $125,000.

Brazier & Simonson, architects, have drawn plans for a brick warehouse to be built on Center Street, near Elm Street. Cost, $80,000.

Lamb & Rich, architects, have planned a new brick edifice for the Washington Heights church at 145th Street, corner Convent Avenue. Cost, $80,000.

CHICAGO. — Building operations in Chicago are not large enough to attract much attention, unless we except the high board fence which the government has extended entirely around the block comprising the site of the new post-office. An advertising company will make beautiful this lofty screen. Think of 1,600 lineal feet of soap and breakfast food advertisements 12 ft. high shutting out the curious eyes of all the citizens who are patriotically anxious to see that all the pile foundations are properly driven!

While building statistics show an average of greater value as compared with the activity a year ago, yet business is slow. In the long list of Chicago building permits issued during a period of two weeks only three items were for buildings exceeding $14,000 in value, and only one was above $20,000. This latter was a street railway power house, by D. H. Burnham & Co., the cost being given at $65,000.

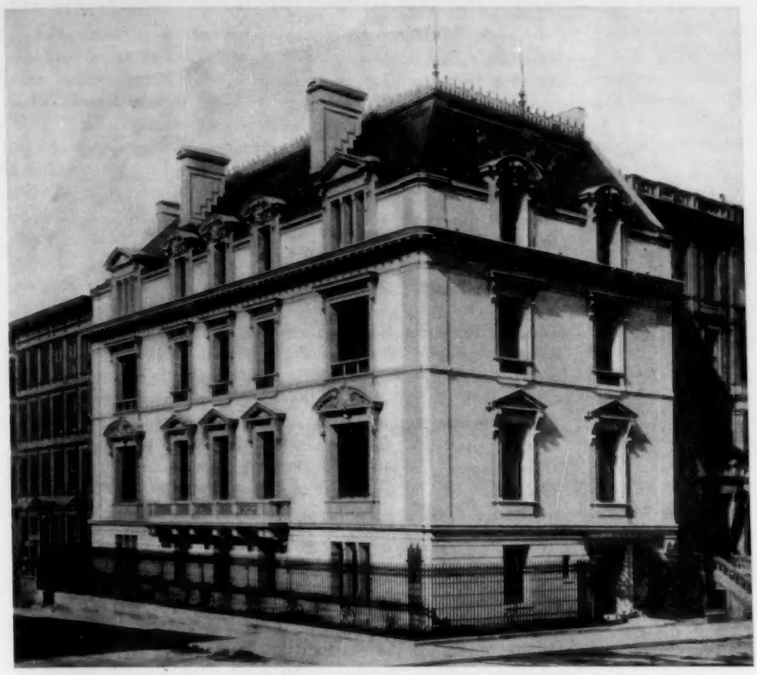
A new building project is a large factory for the New York Biscuit Company. The improvement, it is said, will amount to $250,000. Mr. S. A. Treat is the architect.

The school board, as usual, has some new school buildings under way; W. S. Patton, architect.

A fire-proof apartment building, to cost $125,000, has been reported. Mr. August Brosseau is named as the owner, who is having the plans made.

ST. LOUIS. — There is evidence of continued improvement in the building line in this city, and the outlook for the future is improving. The opinion seems to prevail, even among the most conservative, that the coming year will be the commencement of an unprecedented building era, and the number of investments being made by outside capitalists in the manufacturing and wholesale districts, and the large number of factories coming here from other cities, or being inaugurated among our own people, lends a color of truth to the prediction.

Only recently the Liggett-Myer Tobacco Company, finding it advisable to concentrate their business, erected in Dundee Place perhaps the largest tobacco manufactory in the world. The site is quite a



RESIDENCE FOR R. FULTON CUTTING, ESQ., 67TH STREET AND MADISON AVENUE, NEW YORK CITY.
Ernest Flagg, Architect.

distance from the business portion of the city, and at the time of its commencement was in a comparatively unsettled part of the city. The plant itself cost upwards of one and a half million dollars, and equally as much more has been expended in the immediate neighborhood in providing homes for the employees, etc.

In addition to this, the same architect, Mr. Isaac Taylor, has just awarded the contract for another tobacco factory in the same vicinity, being on Park Avenue and Lawrence Street. The building is for the Wellman-Dwire Tobacco Company, who intend moving here from Quincy, Ill., and is five stories high and 300 ft. long. The cost will be $100,000.

Eames & Young have let the contract for a five-story, slow-combustion building for the Cupples Real Estate Company. The building is one of the large number of buildings built by this company within the last few years at what is known as Cupples Station, the heaviest wholesale district in the city.

Another long-felt want is about to be provided in the erection of a passenger station at Vandeventer Avenue by the Wabash Railway. Architect A. M. Beinke's plans call for a building 100 by 350 ft., with Bedford stone for the basement, while granite brick and white terra-cotta will be used in the superstructure.

The same architect is also building a 60 by 130 ft. addition to the Christian Orphans' Home on Auburt Avenue.

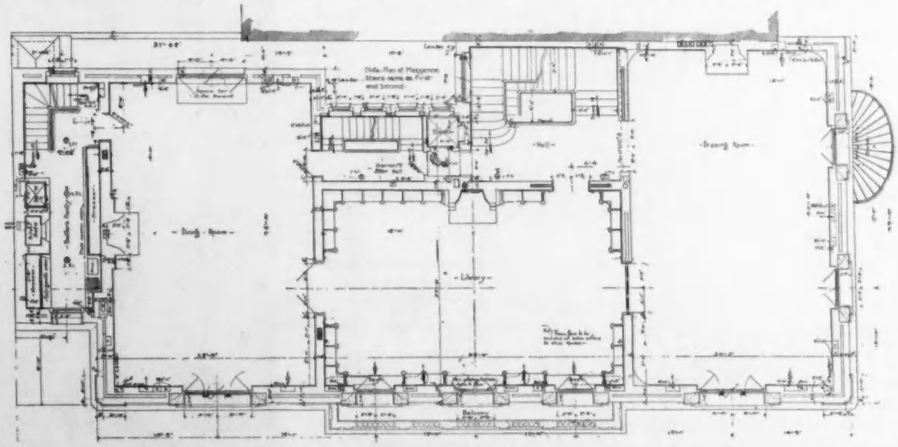
There has been another effort made to improve the northeast corner of Pine and 9th Streets, and it is to be hoped that better success may attend the effort than heretofore. This corner has had a peculiar history, two prominent citizens identified with schemes for its improvement having taken their own lives. After numerous failures by others, the owners undertook the erection of a ten-story building, but about the time the foundations were finished the stringency in financial circles caused a suspension of work, which has just been resumed again. The original idea of making the building ten stories will not be carried out at present, but seven are to be finished now, and later on it is expected that the other three stories will be added. Brick and terra-cotta will be used for the street fronts, while the construction will be of steel. About $150,000 will be expended.

The beautiful club house of the St. Louis Country Club, at Claton, which was destroyed by fire a few weeks ago, is to be rebuilt on a grander scale, and Shepley, Rutan & Coolidge have the plans about completed for same.

The same firm is also building a residence in Portland Place for Mr. J. H. Holmes, which will cost $65,000.

BUFFALO.— The better feeling amongst builders, which was noticed some two months ago, is pushing itself forward, and though, so far as large buildings are concerned, there is not a great deal of show, the building trade generally shows unmistakable signs of returning prosperity. There is already a slight rise in prices, which, it is to be hoped, will continue.

Last month the specifications for the new armory for the 74th Regiment, N. G. N. Y., were issued, and bids were asked for, with the result that the lowest bid was close on to $125,000 higher than the amount appropriated by the legislature. Naturally, there were only two courses before the commissioner, viz., either to take the lowest and finish the building as far as possible and trust to another appropriation, or to so modify the plans that the building might be



FIRST FLOOR PLAN.
RESIDENCE FOR R. FULTON CUTTING, ESQ., 67TH STREET AND MADISON AVENUE, NEW YORK CITY.
Ernest Flagg, Architect.
Elevations shown in plates 85, 86, and 87.

RESIDENCE, EDGEWATER, ILL.
George W. Maher, Architect.
Roofed with Spanish A tile. Manufactured by the Chicago Terra-Cotta Roofing and Siding Tile Company.

completed within the amount, $375,000. The latter course prevailed, and the State architect is now working hard on the plans, etc., in order to bring about the desired result. Captain Lansing, the resident architect, says that it is altogether likely that the building, instead of being built of stone, will be brick, though he thinks that the specifications could be cut down so as to leave the outer shell of stone, whilst altering the interior so as to bring the cost down to the required figure.

Phillips & Graves have prepared plans for a four-story brick and stone flat building on the corner of Main and Balcom Streets, to cost $50,000.

Architect Coxhead has made drawings for a new Roman Catholic school for the parish of St. Bridget's. It is to be built of brick with terra-cotta trimming, at a cost of $40,000.

Pentecost & Baggaley have filed plans for a five-story brick flat building, ten families, for Mr. W. Larkin, at 74 Day's Park. It will be practically fire-proof, and will have every convenience, including electric elevator.

Lansing & Beierl have deposited plans with the Bureau of Building for a Roman Catholic church on the corner of Alabama and Sandusky Streets. It will be built entirely of undressed stone, and will cost, exclusive of the interior fittings, about $40,000.

The new Federal building is beginning to look as though some thing were being done. The walls are now up to the second-story joists, and if the remainder of the work can be judged from present appearances, the building will be a credit to the contractor, and a decided acquisition to the architecture of Buffalo.

The competitive designs prepared by the eight selected local architects for the new banking premises for the Buffalo Savings Bank, to be erected on the corner of Main and Huron Streets, have been sent in, but it is not at all likely that any decision will be arrived at in the near future, as it has been decided not to start on the building until next spring.

BOSTON.—During the past thirty days there seems to have been a decided improvement in the condition of affairs as regards the building business in this city, and extending generally throughout New England. There are rumors of a number of large building operations that will in all probability come into the market before the first of the year. In the meantime contracts are being awarded, or at present being filled, on some fair-sized work, the plans of which have recently been completed. There is certainly considerable activity in the building of apartment houses in Boston and in the outlying sections. A larger number of these are being constructed of brick in preference to other materials than have been heretofore, which is encouraging evidence as to the increased popularity of well-constructed brick buildings, as compared with the flimsy wooden structures that in years past have been erected in sections where the law permitted.

Among the new buildings either now under process of construction or on which work will shortly be begun may be mentioned a large business block on India and Sears Streets, Hon. John D. Long, owner; Rand & Taylor, Kendall & Stevens, architects; to be constructed of brick. A $75,000 apartment house, corner of Brimmer and Pinckney Streets, John W. Bemis, architect, with Cabot, Everett & Mead, Boston; to be constructed of brick and limestone. The Boston Eye and Ear Infirmary's new hospital on Charles Street, Shaw & Hunnewell, architects. A $200,000 office building on India Street, Charles M. Dean, owner; Hartwell, Richardson & Driver, architects; George A. Fuller & Co., contractors; to be constructed of brick. New engine house for the Grove Hall district, Boston, Perkins & Betton, architects; L. K. Marston, contractor; to be constructed of brick and terra-cotta. The new building for the Massachusetts Institute of Technology (plans for which were prepared last year), to cost $150,000, Professors Chandler & Homer, architects; to be constructed of brick and terra-cotta. City Laundry Building, Wheelwright & Haven, architects; to be constructed of brick. New car house for the West End Street Railway, at Forest Hills, Boston; to be constructed of brick. Free Baptist Church, Warren Street, Roxbury, Mass., A. L. Darrow, architect; to be constructed of brick. New Catholic Church, to cost $100,000, at Whitinsville, Mass., for the St. Patrick's Catholic Parish, Charles D. Maginnis, architect, Boston; to be constructed of brick and stone. $200,000 building for the Hartford Brewing Company, Hartford, Conn. Adam C. Wagner, architect, Hartford; to be constructed of brick. $50,000 business block, Malden, Mass., Tristram Griffin, architect, Boston; to be constructed of brick. $150,000 hotel at Pittsfield, Mass., Samuel W. Bowerman, owner, Pittsfield, H. Neil Wilson, architect, Pittsfield; to be constructed of brick and stone. Society hall and dormitory at New Haven, Conn., Brite & Bacon,

RESIDENCE, COMMONWEALTH AVENUE, BOSTON.
McKim, Mead & White, Architects.

EXECUTED IN TERRA-COTTA FOR THE ERIE LIBRARY, ERIE, PA.
Alden & Harlow, Architects.
By the Northwestern Terra-Cotta Company.

architects, New York City; to be constructed of brick. New high school at Brockton, Mass., C. L. Mitchell, architect, Brockton. New school, Fall River, Mass., L. G. Destremps, architect, Fall River; to be constructed of brick.

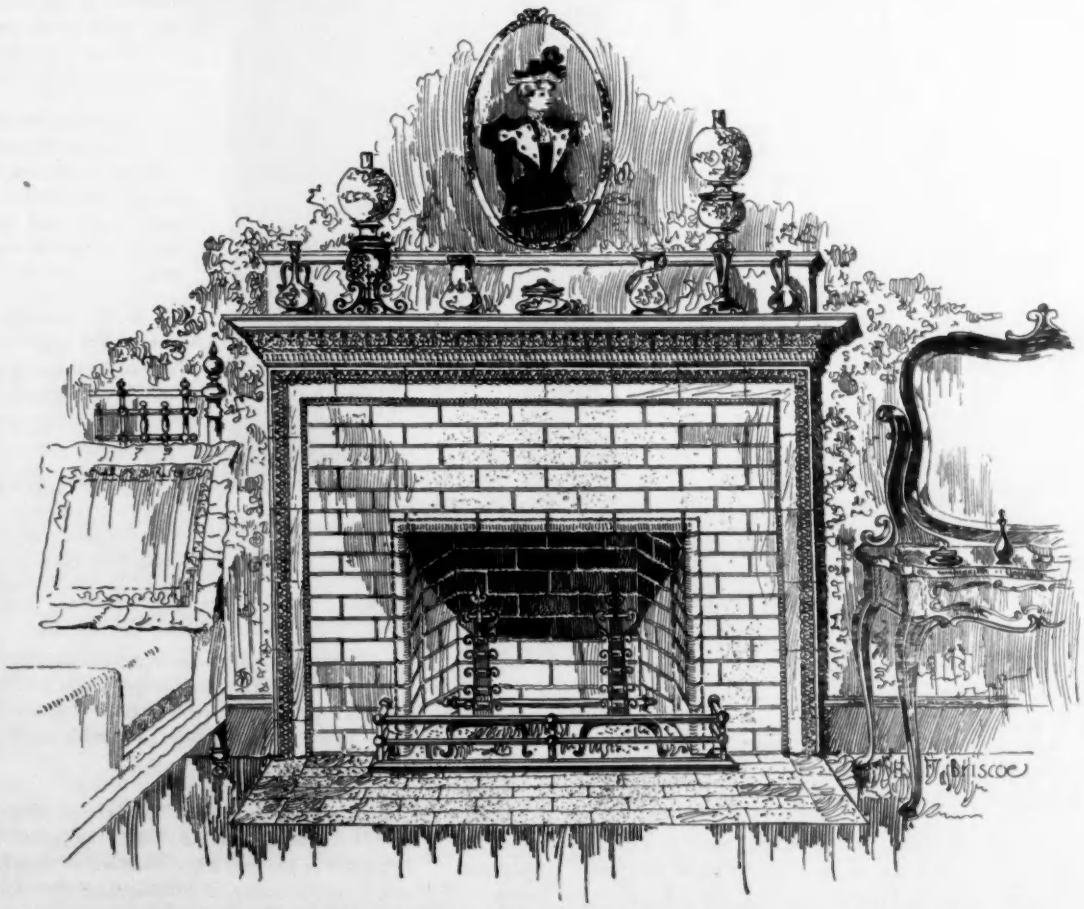
NEW TRADE LITERATURE.

THE disposition to freely introduce the open hearth as an essential and important feature in the construction of the modern dwelling is certainly a tendency in the right direction, and one that deserves every encouragement.

Viewed both from an artistic and sanitary standpoint, the general adoption of the open fireplace in the living and sleeping rooms of our habitations is most desirable and should be strongly urged. No part of our home contributes more to the comfort and health of the inmates than the chimney corner. Its quiet influence of good cheer is impressive and restfully effective, while the peaceful charm of its bright circle lends contentment to the mind. Taken from a sanitary standpoint, the open hearth has much to recommend it. Perfect ventilation is a necessity for any healthy habitation, and the best possible ventilator is an open fireplace. With the coming of the hot-air furnace the fireplace passed into disregard. For many years its virtues were ignored and its artistic possibilities lost sight of. Comparatively very few of the new houses then erected embodied the fireplace in their construction, while most of those that existed in the old habitations were sealed from use. Within the past few years all this has changed; the claims of the open hearth to popular favor are once more recognized and far better understood. At present there is hardly a structure built for residential purposes but that contains its open fireplace, no matter how inexpensive is the dwelling.

In connection with this subject an interesting and instructive volume has reached our table, which we earnestly recommend to the attention of our readers. This work is entitled "The Open Hearth," and is issued by Fiske, Homes & Co., 166 Devonshire Street, Boston, for distribution among the architects and builders. While this work is published with the objective view of bringing to the attention of the architectural profession the large assortment and artistic beauty of the line of fireplaces which the firm manufactures, yet in its compilation they have gone far beyond the standard of a mere catalogue, and have amassed together such material as make it of real interest to the architect, by virtue of the many valuable suggestions therein contained.

There are some thirty full-page illustrations of the different styles of fireplaces that the firm carry in stock, facing which, on the opposite page, is a full description of the fireplace illustrated. These designs embrace a wide range of patterns, each being especially adapted to harmonize with the particular requirements of various



BRICK AND TERRA-COTTA FIREPLACE MANTEL, DESIGNED FOR FISKE, HOMES & CO., BOSTON.
Built of 8½ by 2½ in. bricks, with a border and shelf course enriched by leaf and bead and reel moldings. Height, 57 ins.; height of shelf, 50 ins.; projection of shelf, 7½ ins.; width, 64 ins.

rooms, from banquet hall to bath room, and range in price from the most expensive of patterns to those of a surprisingly low cost.

We certainly recommend to our readers a careful perusal of "The Open Hearth," a complimentary copy of which may be had by addressing Fiske, Homes & Co., 166 Devonshire Street, Boston, Mass.

WE are in receipt of a very interesting catalogue from the Lehmann-Kohlsaat Clay Works, Chicago, that explains in a most comprehensive way a number of new and special features which the firm are introducing in a line of clay products now being placed by them upon the market. A very complete set of over seventy illustrations serve to make the purpose of these features easy to comprehend.

Special attention is called to what they term their "Angle Iron Fire-proofing Construction, Wall, Floor, Ceiling, and Roof, all made of the same tile in connection with angle iron, which offers a perfect protection of the iron and wood construction, combines lightness with strength, and can be constructed with ease and economy."

The particular feature of this invention is the embedding entirely of the angle iron between the tiles.

Now that the subject of the best and most approved methods of fire-proofing is justly receiving so much attention, it would not be amiss for such of our readers as are interested in the question to obtain a copy of this catalogue. Address Lehmann-Kohlsaat Clay Works, Chicago, Ill.

ITEMS OF INTEREST AND VALUE.

THE contract for the buff terra-cotta for Everett, Mass., grammar school has been awarded to Waldo Brothers.

T. W. CARMICHAEL, manufacturer of clay steamers, has removed from Wellsburg, W. Va., to Clarksburg, W. Va.

THE white terra-cotta to be used in the new Casino and Pergola for Hon. Charles F. Sprague, Brookline, Mass., will be furnished by Waldo Brothers.

T. W. CARMICHAEL reports the sale of his fifteenth clay steamer for the season, the purchaser being the Clarksburg High-Grade Shale Brick Company, Clarksburg, W. Va.

THE Gale Automatic Safety Sash Lock will be used in the Dun Building, at the corner of Broadway and Reade Street, New York City; Harding & Gooch, architects.

WALDO BROTHERS are furnishing Alsen Portland and Hoffman Rosendale cement to Norcross Brothers for Congregational Building, Beacon Street, Boston.

G. R. TWICHELL & Co., Boston, have secured the contract to supply the buff brick to be used in eight apartment houses on Washington Street, Brookline, Mass.; also four apartment houses at Allston, Mass.

WALDO BROTHERS have secured the cement contract for Longwood Avenue Bridge, Boston, furnishing Atlas Portland and Hoffman Rosendale; Woodbury & Leighton, contractors.

THE CONKLING, ARMSTRONG TERRA-COTTA COMPANY have secured through their New England agent, Charles E. Willard, Boston, the terra-cotta on the St. John's Parish Church, East Boston, Mass.

WALDO BROTHERS have the contract for furnishing the white terra-cotta for new Telephone Building, Newport, R. I.; Perkins & Betton, architects, Boston. Elaborate modeling will be used.

THE MOUNT SAVAGE ENAMELED BRICK COMPANY, Mount Savage, Md., have secured through their New England agents, G. R. Twichell & Co., Boston, the contract to supply the enameled brick to be used in a residence at Somerville, Mass.; Samuel D. Kelley, architect; D. W. Welch, builder; also a residence in Readville, Mass.; Karl Zerrahn, architect; Mitchell & Sullivan, builders.

TERRA-COTTA MULLIONS, SHOWING FACE AND REVEAL, STORE FRONT, CHESTNUT STREET, PHILADELPHIA, PA.
F. R. Watson, Architect.
Made by the Conkling, Armstrong Terra-Cotta Company.

CHARLES E. WILLARD, Boston, has secured the contract to furnish the white brick to be used in a large business block in Worcester, Mass., also the fire-proofing to be used in the L. W. Bessee Block, Springfield, Mass.

THE RIDGWAY PRESSED BRICK COMPANY, Ridgway, Penn., have secured through their New England agents, G. R. Twichell & Co., the contract to supply the gray brick to be used in the new Catholic Church, at Jamaica Plain, Mass.; P. W. Ford, Boston, architect.

THE SHAWMUT BRICK COMPANY have secured through their Boston agent, Charles E. Willard, the contract to furnish the buff brick on the Moriarty Block, Waterbury, Conn., and in the residence for the Sisters of the Sacred Heart, Jamaica Plain, Mass.

G. R. TWICHELL & Co., Boston, have secured the contract to supply the brick to be used in the new car house for the West End Street Railway, at Forest Hills, Mass.; also for a new schoolhouse, at Dedham, Mass.

THE WEBSTER BRICK COMPANY, South Webster, Ohio, have secured through their New England agent, Charles E. Willard, Boston, the contract to furnish the mottled brick in the Standhope Building, Providence, R. I.

IT will interest those using Portland cement to learn that the N. Y. C. & H. R. R. R. Company has just executed a contract to use Alpha Portland cement stone entirely in the erection of the new Grand Central Station, 42d Street and Vanderbilt Avenue, New York City.

A CONTRACT has just been closed by Edward R. Diggs & Co., for placing nearly five hundred of the Bolles' Sliding and Revolving Windows in the new office building of the English-American Loan and Trust Company, of Atlanta, Ga.; Bradford L. Gilbert, architect, of New York.

THE SAYRE & FISHER COMPANY have secured through their

Boston agent, Mr. Charles Bacon, the contract to supply the gray mottled brick to be used in the new Terminal Station, at Boston; Shepley, Rutan & Coolidge, architects; Norcross Brothers, contractors. These bricks are of a special color, and of Norman shape (dimensions, 12 by 4 by 2¼ ins.).

MEEKER, CARTER, BOORAEM & Co., New York City, have, since May 1, 1897, sold over eight million paving brick for the Eastern Paving Brick Company, for whom they are Eastern selling agents. Their last contract, recently closed, calls for six million bricks to be supplied the town of Jamaica, N. Y., which will be used in gutters on forty miles of street improvement, the roadways being macadamized. This is one of the very largest, if not the largest contract for paving brick ever closed in this country.

THE RIDGWAY PRESSED BRICK COMPANY, Ridgway, Penn., have secured through their Boston agents, G. R. Twichell & Co., the contract to supply the gray brick in the Free Baptist Church, Roxbury, Mass.; A. L. Darrow, architect, Boston; also the gray brick to be used in eight apartment houses, corner of Columbus Avenue and Northampton Streets, Boston; D. D. Kerns, architect; also the gray brick to be used in the apartment houses on Northampton Street; T. A. Tracey, architect.

THE AMERICAN ENAMELED BRICK AND TILE COMPANY are supplying their patent interlocking tile for the halls of the College of History, American University, Washington, D. C.; James L. Parsons, builder; also the elevator shafts in the Gatlin Building, Hartford, Conn.; Hopkins & Roberts, builders. They are also making a large delivery on contract closed three months ago, to supply semi-glazed front brick for the new Dun Building, Broadway and Reade Streets, New York City; W. A. & F. I. Conover, builders.

TERRA-COTTA CAP TO COLUMN, INTERIOR OF ENTRANCE, SYRACUSE UNIVERSITY, SYRACUSE, N. Y.
Green & Wicks, Architects.
Made by the Perth Amboy Terra-Cotta Company.

THE CELADON TERRA-COTTA COMPANY have recently supplied their roofing tiles on the following work: Residence, W. B. Snyder, Newark, N. J., buff Conosera; Thomas Cressey, architect. Residence, W. H. Lawrence, Cleveland, Ohio, red Conosera; Coburn & Barnum, architects. Passenger station, Illinois Central Railroad, Springfield, Ill., red closed shingle; F. T. Bacon, architect. Gate lodge, National Soldiers' Home, Dayton, Ohio, brown Conosera; Peters, Burns & Pretzinger, architects. Gate lodge, Woodlawn Cemetery, Everett, Mass., red open shingle; Wm. Hart Taylor, Boston, architect.

THE OHIO MINING AND MANUFACTURING COMPANY, makers of the "Shawnee" front brick (works at Shawnee, Ohio), have sent us four samples of their product, which we are glad to recommend as being a splendid brick in every particular.

The colors are a light mottled buff, a dark mottled buff, a cream white, and a chocolate brown. The surface texture of the bricks is fine, and the sharp metallic ring which they give when struck with a hammer shows that the clay has been well burned, which is one of the principal requisites of first-class brick.

"PEOPLE have gone wild on the reports of rich gold finds in Alaska, and are willing to undergo the perils and discomforts of the frigid North to extract from its frozen soil the nuggets which will bring them wealth. You don't need to go to Alaska! There is a 'golden opportunity' right here at home. It lies within your power to extract from the earth around you 'golden bricks,'" says the American Clay-Working Machinery Company, on an attractive novelty advertising card which they have recently sent out. "Your clay with our machinery will bring you gold without the privations of Alaska. The demand for good brick and other clay products is going to be heavy; get ready to meet it."

A NOVEL application of the Mason Safety Tread has recently been completed in New York, which attracts the notice and elicits the commendation of pedestrians. Set in the sidewalk in front of the office of the New York *World* is an immense iron circle representing the globe. As the sidewalk toward Frankfort Street has a decided pitch, this circle, worn to a polish by the great amount of traffic, became a source of constant danger, especially in wet weather. With its smooth outlines and zones covered with stripes of the Mason Safety Tread, the danger of slipping is removed, and the illustrative effect of the great globe is intensified.

WE would call the attention of those of our readers who are interested in the manufacture or sale of clay products, to the particularly desirable property which is offered for sale on page xxxvii of this issue. This property is located in the northwestern portion of Pennsylvania, and is so situated as regards shipping facilities as to have cheap and easy access to the markets of the Middle and New England States. The property is said to contain twelve different kinds of fire-clay and shale in inexhaustible quantities, which burn white, buff, pink, salmon, and red in color. These clays are of such a quality as to be particularly suitable for the manufacture of all kinds of brick and terra-cotta products. The fact of the extreme cheapness of fuel in this section is an item of considerable importance in the cost of manufacturing.

THE CHICAGO TERRA-COTTA ROOFING AND SIDING TILE COMPANY report the following buildings completed last month on which their goods were used for roofing:—

Woodmere Cemetery Gate, Detroit; Donaldson & Meier, architects; house and barn, F. B. Stevens, Detroit; Donaldson & Meier, architects; depot, Kansas City, Pittsburg & Gulf Railroad, Point Arthur, Texas; George Matthews, Architects; residence for P. Wheeler, Mr. Pruyn, architect; office East End Avenue, Chicago, building, Battle Creek Steam Pump Company, Battle Creek, Mich.; R. T. Newberry, architect; residence, Michigan Avenue, Chicago; Charles S. Frost, architects; two houses for Mrs. Fellows, Chicago;

RESIDENCE AT PORTSMOUTH, N. H.
Ball & Dabney, Architects.

Cowles & Ohrenstein, architects; residence, Grand Boulevard, Chicago; J. F. & F. P. Doerr, architects; residence, Sullivan, Ind.; Wing & Mahurin, architects; carriage house for E. S. Pike, Beverly Hills, Ill.; H. H. Waterman, architect; apartment building, Chicago; J. F. & F. P. Doerr, architects; three-apartment building, Chicago; Burtar & Gassman, architects.

THE BOSTON FIRE-PROOFING COMPANY are furnishing the terra-cotta fire-proofing on the following large buildings: The new Converse Building, corner Milk and Pearl Streets, Boston; Winslow & Wetherell, architects, L. P. Soule & Son, contractors. Puritan Brewery, Charlestown, Mass.; Hettinger & Hartman, architects, Mack Brothers, contractors, Salem. Jewelers' Exchange, Bromfield and Washington Streets; Winslow & Wetherell, architects, Geo. A. Fuller & Co., general contractors.

SAYRE & FISHER COMPANY have secured the contract through their Boston agent, Mr. Charles Bacon, to supply the enameled brick to be used in the interior of the new engine house now being built at Grove Hall, Boston; Perkins & Betton, architects, L. R. Marston, contractor.

O. W. PETERSON & Co. are supplying the dark speckled buff brick for the St. Alphonso Hall, Roxbury; F. Joseph Untersee, architect.

CHARLES E. WILLARD is supplying the old gold mottled brick that is being used in the Macabe Building, New Britain, Conn.; W. H. Cadwell, architect, New Britain, O. W. Curtis, contractor.

THE STANDARD TERRA-COTTA COMPANY are supplying, through their New England agents, O. W. Peterson & Co., the terra-cotta for a new hotel at the corner of Snow and Weybosset Streets, Providence, R. I.; W. R. Walker & Sons, architects, Providence, M. J. Houlihan, contractor.

For Sale.

Brick Plant and Clay Farm in Sayreville Township, Middlesex Co., N. J., on Raritan River, about 3 miles above South Amboy. 282 acres rich deposit of Terra-Cotta, Fire, Red, Blue, and Buff Brick, and Common Clays. Facilities for shipping by Water or Rail. Fully equipped Factory, Dwellings, Office, Store, etc., etc. For further particulars apply to W. C. Mason, 272 Main St., Hartford, Conn., or W. Mershon, Rahway, N. J.

Want One?

If you want a Fireplace Mantel don't take the first thing you see. Be sure and get the right kind — the best kind. Be sure and get one of ours made of Ornamental Brick. They are the newest and best — the most appropriate and durable. They don't cost any more than other kinds, and are easily set up by local brick-masons. Our designs are artistic and correct. Each one was prepared by a noted architect. Don't order a mantel before you have learned about ours. Send for our Sketch Book of 52 designs of mantels costing from $12 up.

PHILA. & BOSTON
FACE BRICK CO.,

15 LIBERTY SQUARE, BOSTON, MASS.

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DYCKERHOFF PORTLAND CEMENT

Is superior to any other Portland cement made. It is very finely ground, always uniform and reliable, and of such extraordinary strength that it will permit the addition of 25 per cent. more sand, etc., than other well-known Portland cements, and produce the most durable work. It is unalterable in volume and not liable to crack.

The Dyckerhoff Portland Cement has been used in the Metropolitan Sewerage Construction, Boston, and is now being employed in the construction of the Boston Subway, Howard A. Carson, Chief Engineer.

Pamphlet with directions for its employment, testimonials, and tests, sent on application.

HAM & CARTER,
560 Albany Street, BOSTON.

E. THIELE,
78 William Street, NEW YORK.
Sole Agent, United States.

ALPHA · PORTLAND · CEMENT · COMPANY · ALPHA PORTLAND CEMENT · JAMES A. DAVIS & CO. SOLE N.E. AGENTS. BOSTON, MASS. · MANUFACTURERS ·

"With a true sense of economy we would buy nothing in Europe but of necessity. The gold reserves of our government and individuals would then increase without even the intervention of tariffs."

Alpha Portland Cement

is the most economical. It is the finest ground cement on the market. For that reason it will take more sand and broken stone than any other cement in existence. To-day our best contractors and engineers consider it superior to any imported cement on the market. We guarantee every barrel of the "Alpha" to be uniform in quality, and to pass any requirement yet demanded of a Portland Cement.

WM. J. DONALDSON,
General Agent,
Betz Building, Philadelphia, Pa.

JAMES A. DAVIS & CO.,
Sole N. E. Agents,
92 State Street, Boston.

Union Akron Cement Company,

The Strongest Natural Hydraulic Cement Manufactured in America. In Successful Use for the past Fifty Years.

CAPACITY OF WORKS 2,000 BARRELS DAILY.

SOLE MANUFACTURERS OF THE

Akron Cement,

(STAR BRAND.)

OFFICE, 141 ERIE ST., - BUFFALO, N. Y.

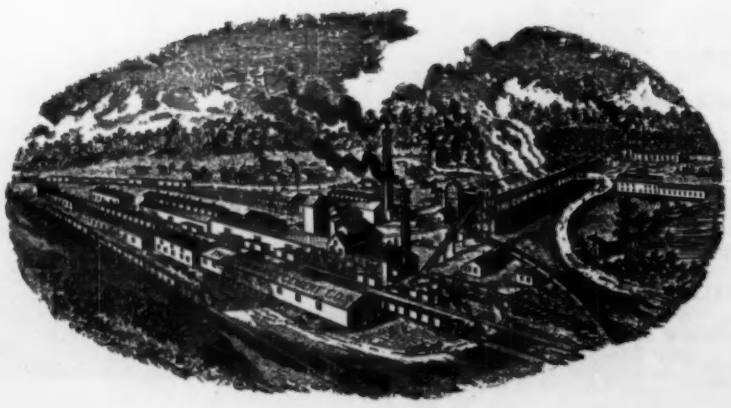
ALSEN'S PORTLAND CEMENT.

The strongest, finest ground, and most uniform Cement in the world. Permits the admixture of more sand than any other, and is the best for mortar or stuccoing.

143 LIBERTY STREET - - - - - - - - - NEW YORK.

WALDO BROS., - - 102 Milk St., Boston.

AGENTS FOR NEW ENGLAND.



ESTABLISHED 1854.

URIAH CUMMINGS, President.
HOMER S. CUMMINGS, Secretary.
Stamford, Conn.

PALMER CUMMINGS, Treas. & Gen'l Mgr.
RAY P. CUMMINGS, Vice-President.
Buffalo, N. Y.

The Cummings Cement Co.

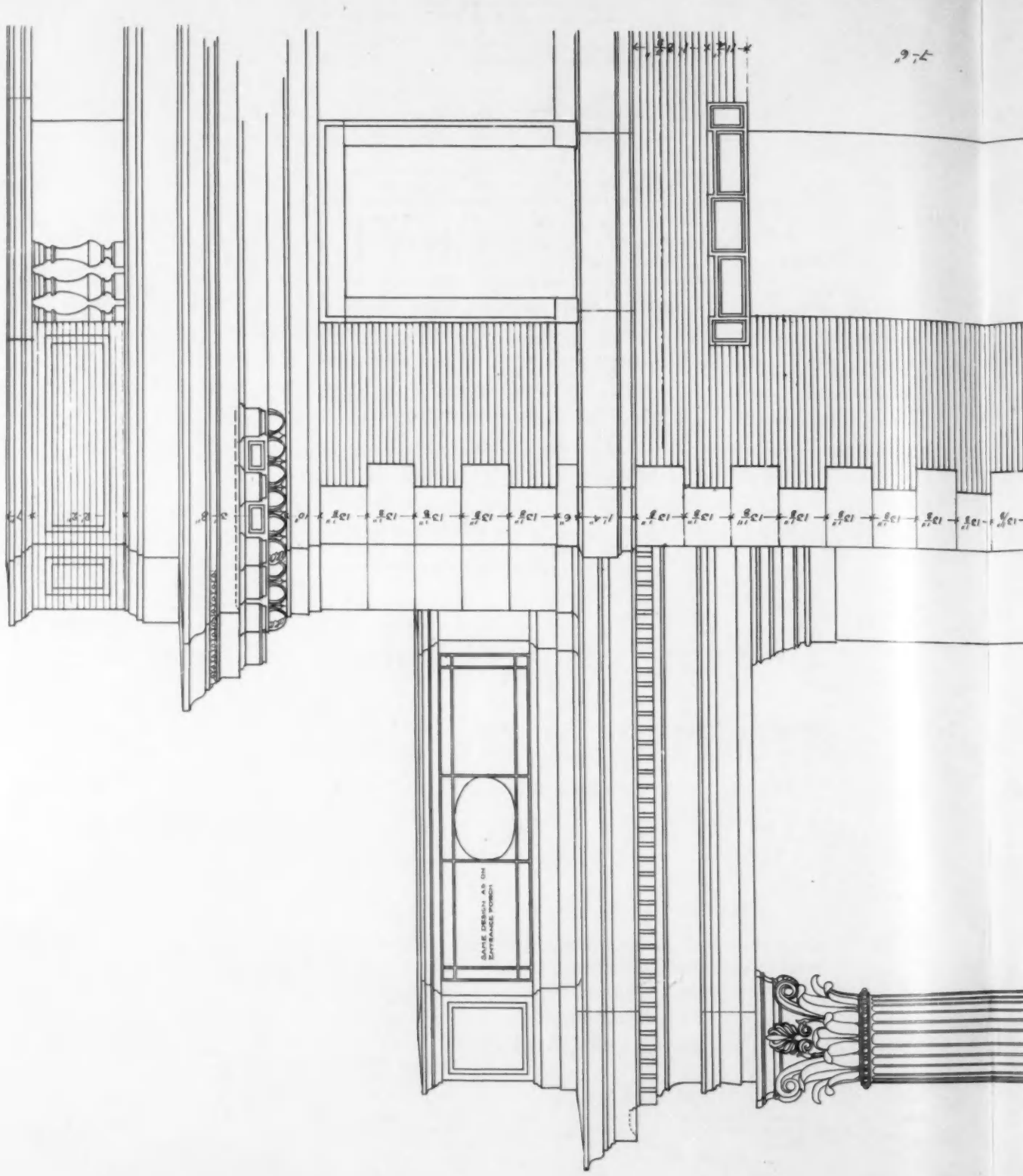
MANUFACTURERS OF

Hydraulic Rock Cement and Portland Cement.

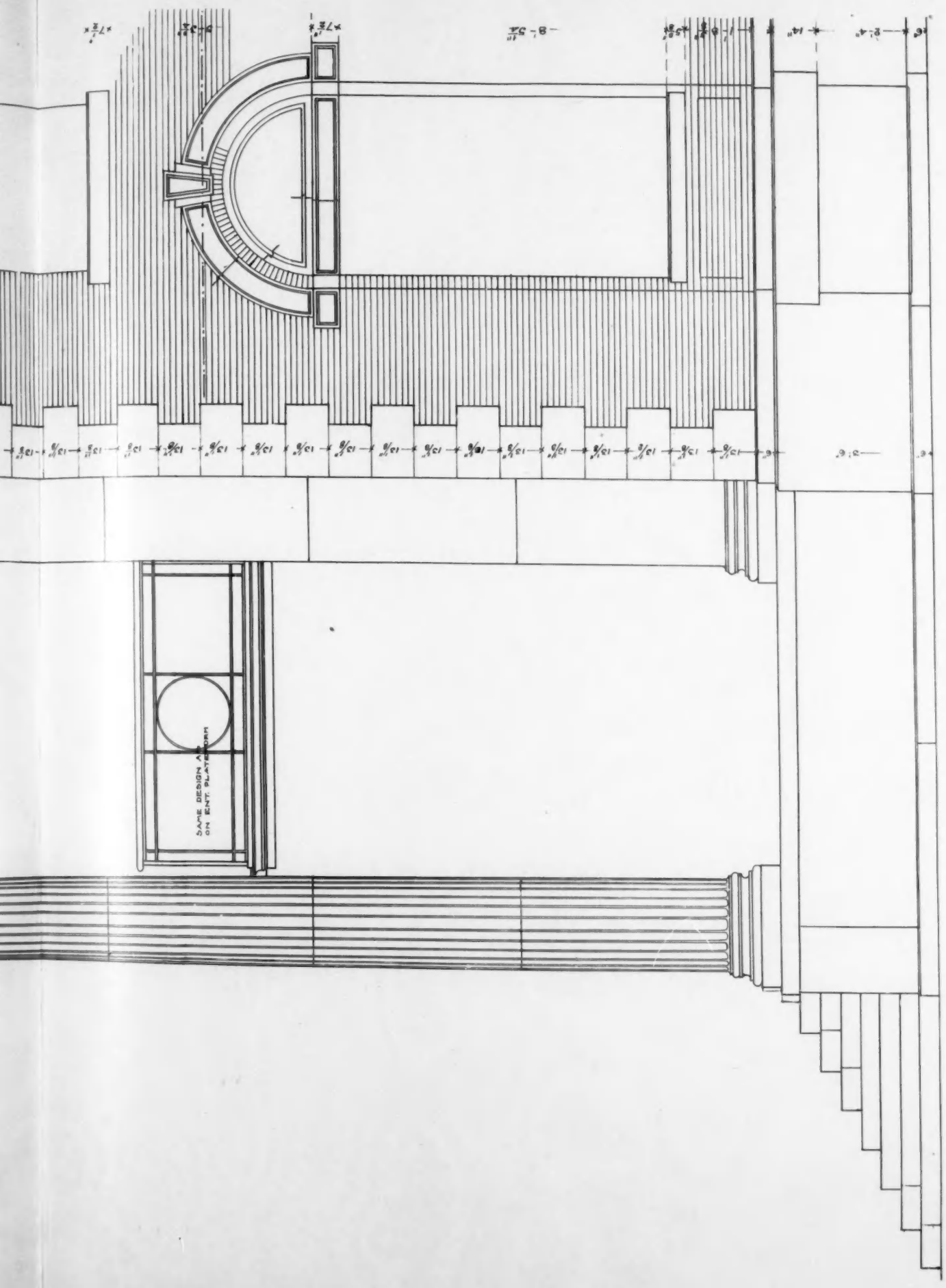
Gen'l Offices: Ellicott Square Bldg., Buffalo, N. Y.

New England Office: Stamford, Conn.

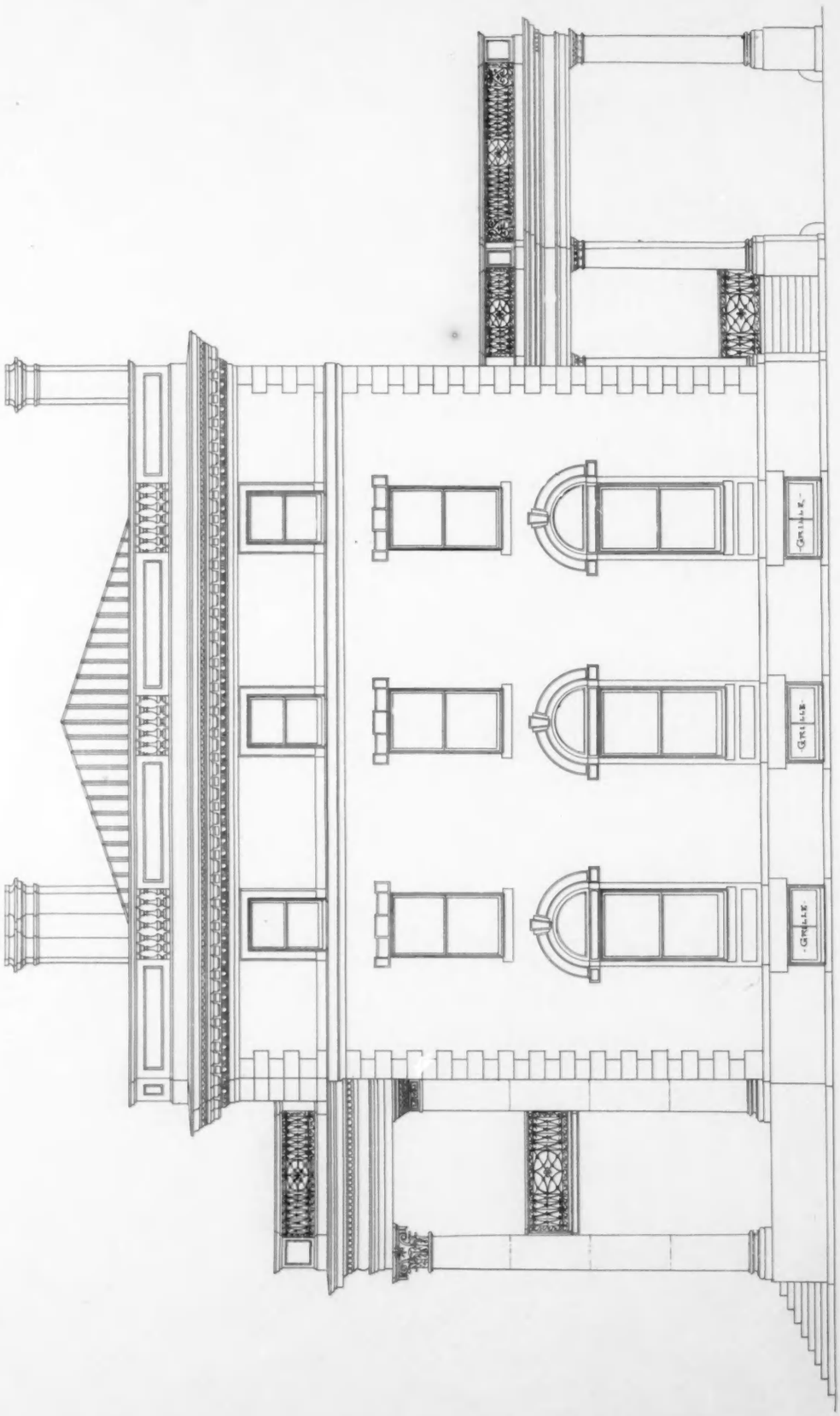
Cement Works at Akron, N. Y. The largest in the United States.


SAME DESIGN AS ON
ENTRANCE PORCH

PLATES 81 and 82.



DETAILS, HOUSE FOR GEORGE L. WILLIAMS, Esq., BUFFALO, N. Y.
McKIM, MEAD & WHITE, ARCHITECTS.

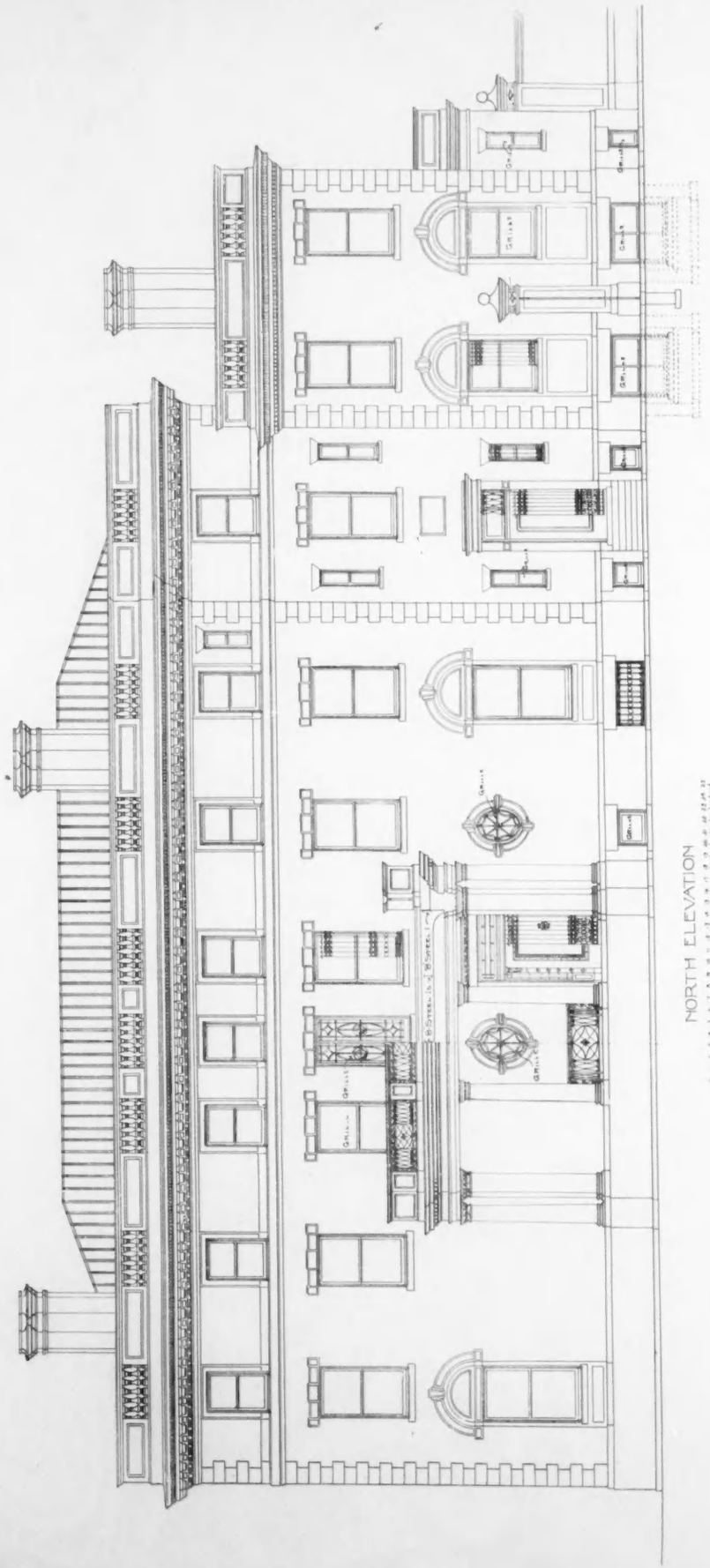


EAST ELEVATION

SCALE

HOUSE FOR GEORGE L. WILLIAMS, Esq., BUFFALO, N. Y.

McKIM, MEAD & WHITE, ARCHITECTS.

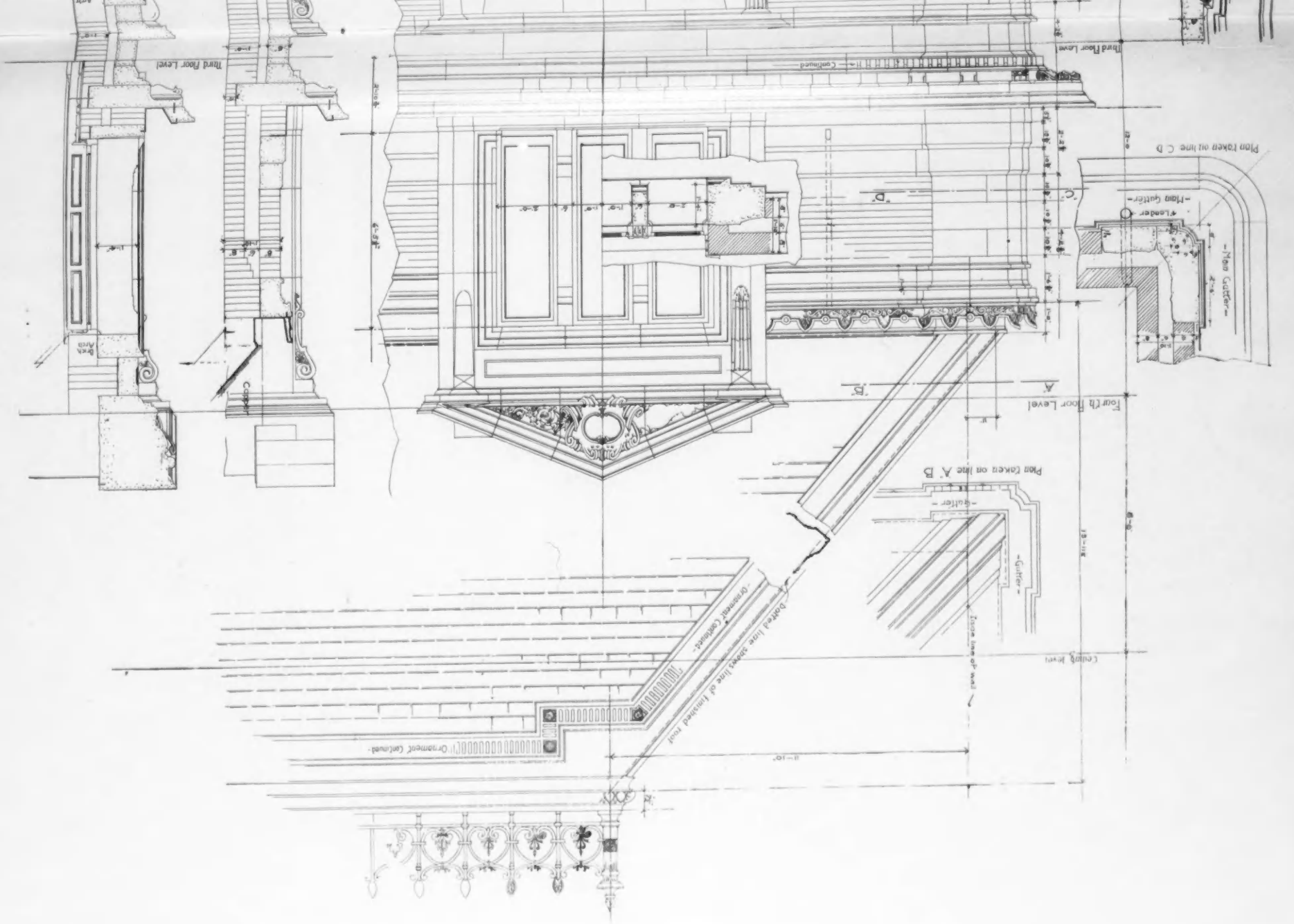


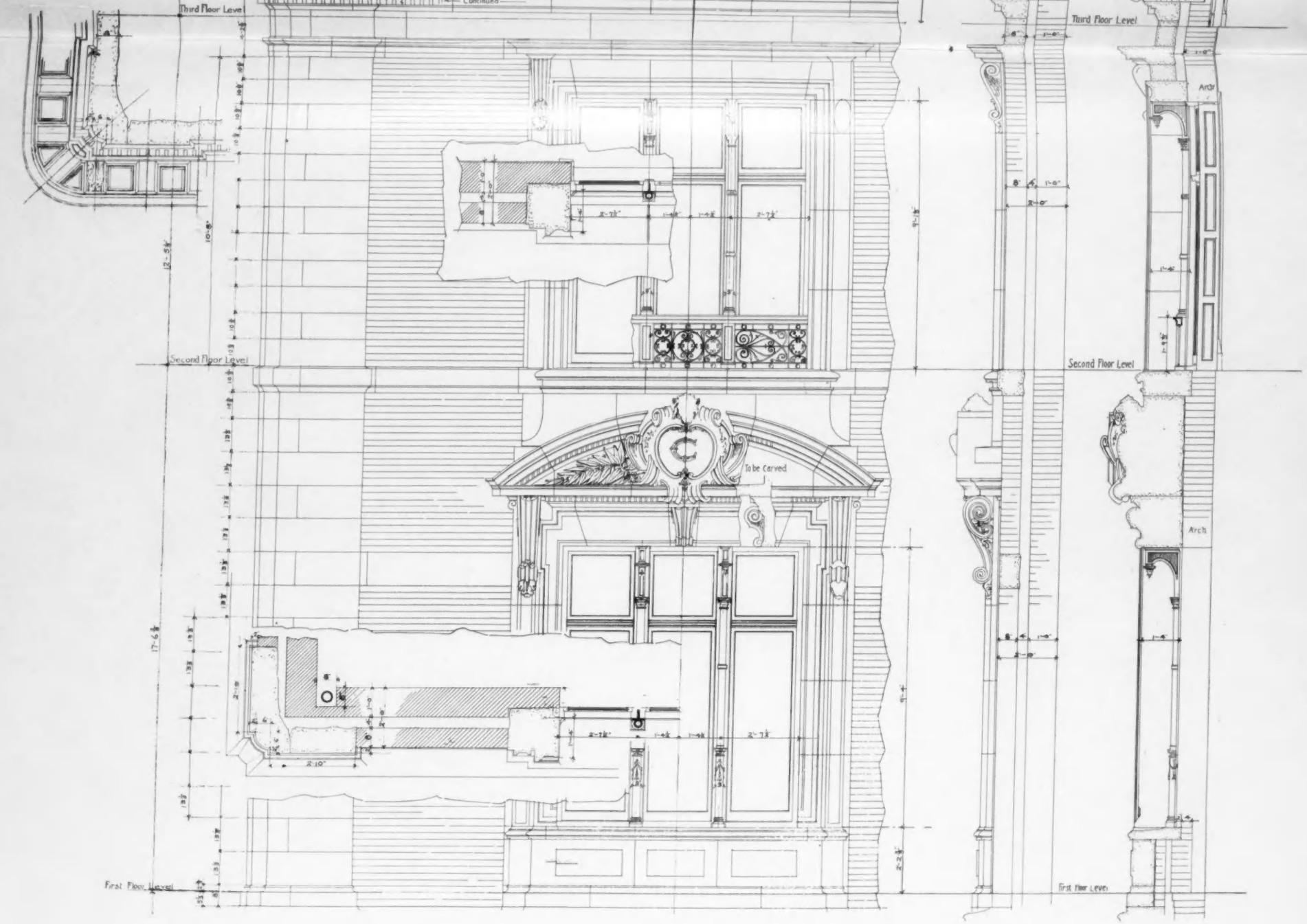
NORTH ELEVATION

SCALE OF FEET

HOUSE FOR GEORGE L. WILLIAMS, ESQ., BUFFALO, N. Y.

McKIM, MEAD & WHITE, ARCHITECTS.

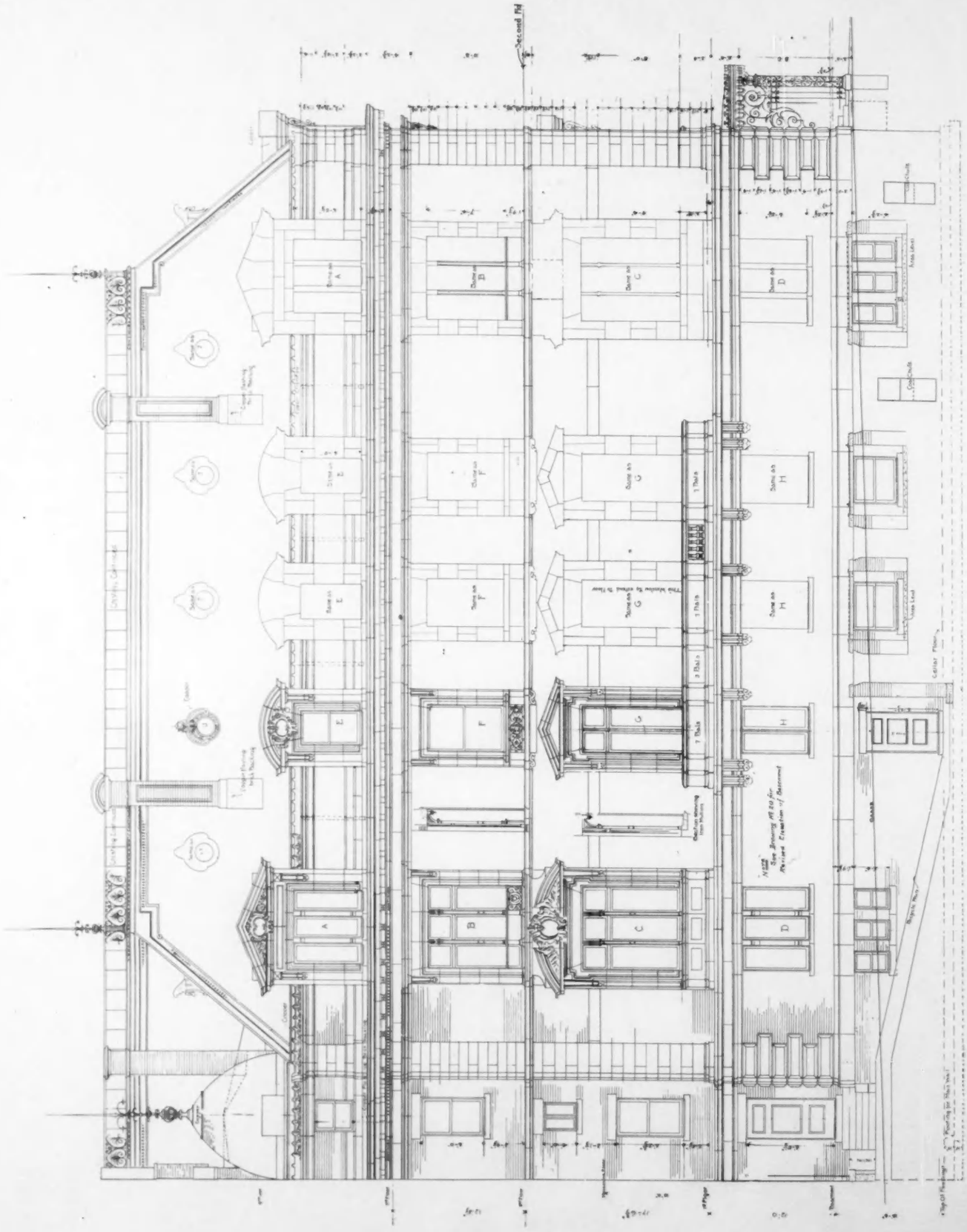

Third Floor Level
Third Floor Level
Plan taken on line C D
Plan taken on line A B
Fourth Floor Level
Ceiling level
Outside line of wall
Dotted line shows line of finished roof
Ornament continued
Gutter
Leader
Main Gutter
Main Cornice
Cornice



RESIDENCE FOR R. FULTON CUTTING, ESQ., MADISON AVENUE, NEW YORK CITY.

DETAILS OF BAY SHOWING TRIPLE WINDOWS.

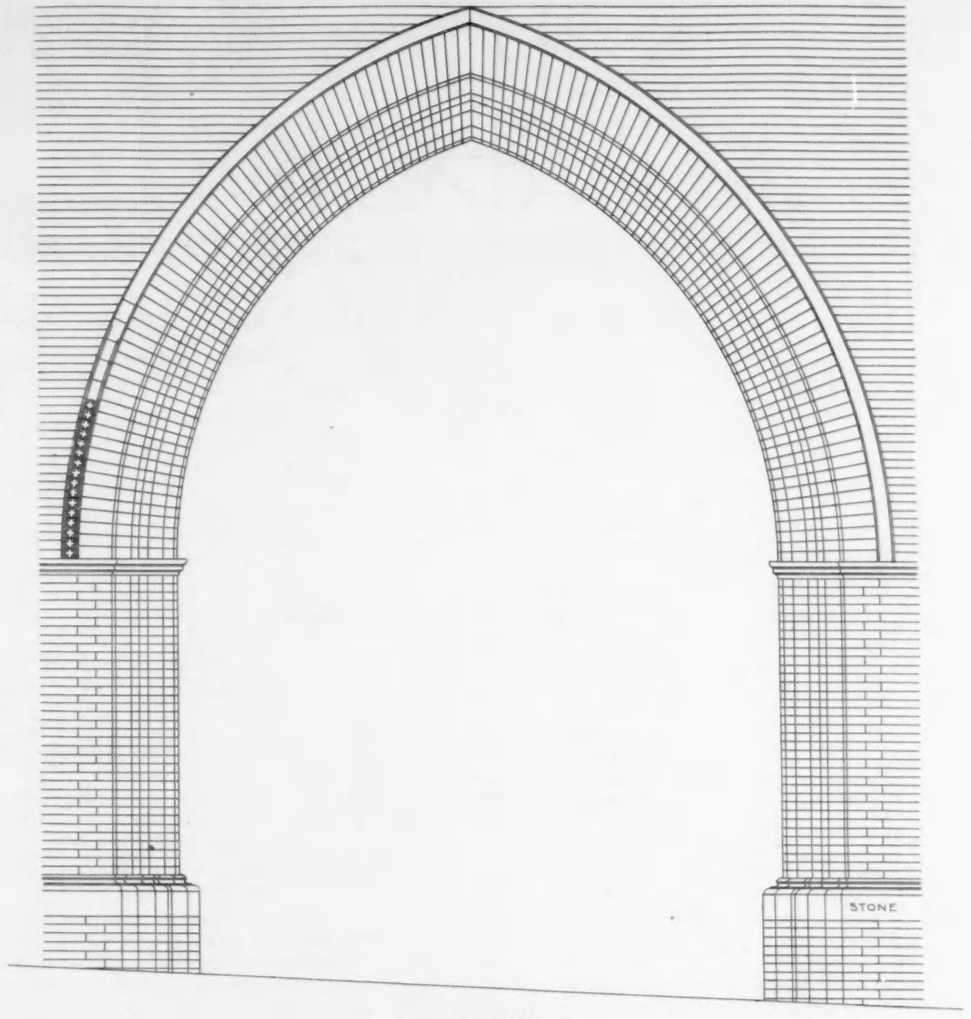
ERNEST FLAGG, ARCHITECT.



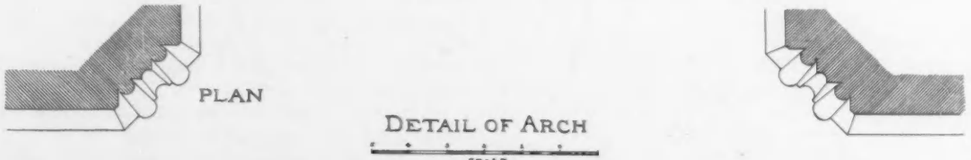
MADISON AVENUE ELEVATION.

RESIDENCE FOR R. FULTON CUTTING, ESQ., 67TH STREET AND MADISON AVENUE, NEW YORK CITY.

ERNEST FLAGG, ARCHITECT.

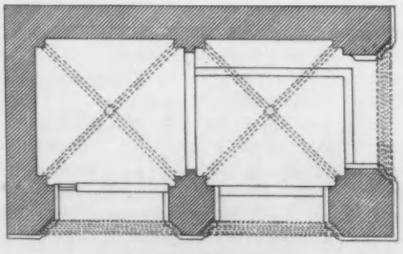


ELEVATION



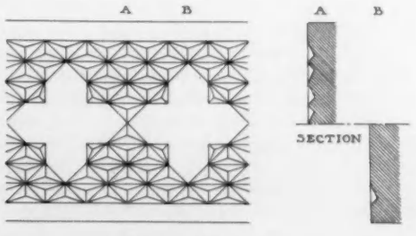
DETAIL OF ARCH

SCALE



PLAN

SCALE



DETAIL OF
ORNAMENT AROUND ARCHIVOLT

SCALE

C.H.ALDEN.

MEASURED DRAWING OF FONTE NUOVA, SIENA.

(This is one of the old fountains owned by the municipality and leased to washerwomen. It was built at the close of the thirteenth century. It is of dark-red brick, 11 ins. x 5¼ ins. x 2¼ ins., bonded irregularly.)

ERNEST FLAGG, ARCHITECT.